

# EARLY DETECTION AND PREVENTION OF PROTEIN CALORIE MALNUTRITION

P.M.SHAH

विशेष काळजी देण्याची कारणे

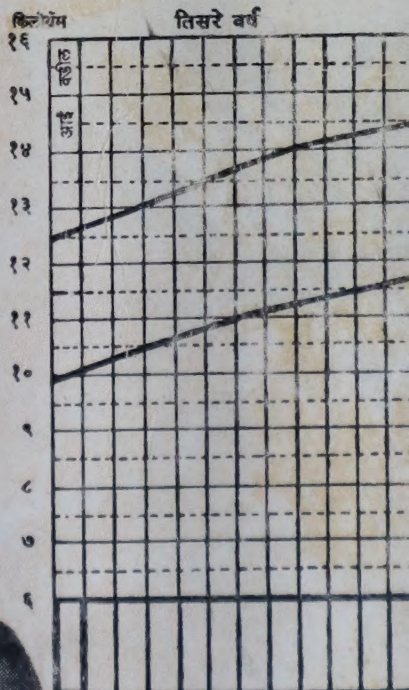
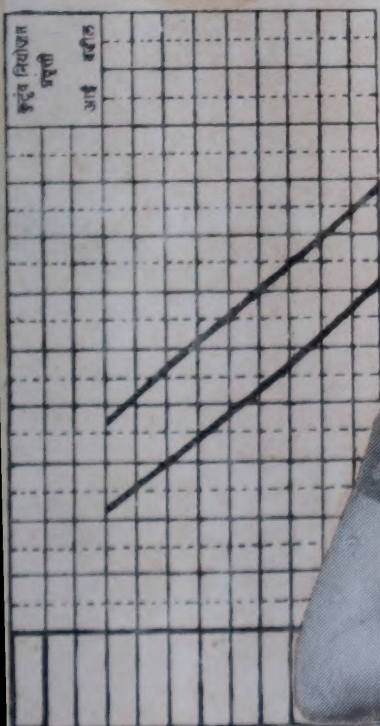
पहिले वर्ष

किलोग्रॅम

दुसरे वर्ष

किलोग्रॅम

तिसरे वर्ष



मासकी



अंडी



चickens



3078



1-10-'76.

326 V Main, I Block Koramangala  
Bangalore – 560 034

[illegible]



EARLY DETECTION AND PREVENTION  
OF  
PROTEIN CALORIE MALNUTRITION



03078

EARLY DETECTION AND PREVENTION  
OF  
PROTEIN CALORIE MALNUTRITION

# Early Detection and Prevention of Protein Calorie Malnutrition



**P. M. Shah**

M.D., D.C.H.,

*Professor of Paediatrics,  
Institute of Child Health,  
Grant Medical College,  
and*

*J. J. Group of Government  
Hospitals, Bombay.*

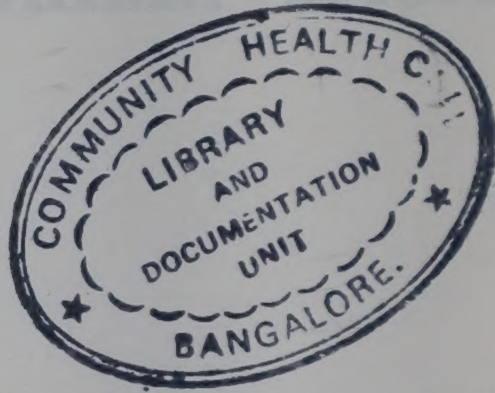


**BOMBAY**

**POPULAR PRAKASHAN**

POPULAR PRAKASHAN PRIVATE LTD

35C Tardeo Road, Popular Press Building, Bombay 400 034



NU7110

© P. M. SHAH, 1974

03078

*First published*

1974

(3149)

PRINTED IN INDIA

BY MANMOHAN S. BHATKAL AT POPULAR BOOK DEPOT PRINTING DIVISION,  
DR. BHADKAMKAR MARG, BOMBAY 400 007 AND PUBLISHED BY RAMDAS BHATKAL  
FOR POPULAR PRAKASHAN PVT. LTD., 35C TARDEO ROAD, BOMBAY 400 034



*Dedicated to my revered father who had been  
a great source of inspiration to me to  
undertake the work in Community Child Health.*

THE UNIVERSITY OF CHICAGO  
LIBRARY  
CHICAGO, ILL.

## FOREWORD

KNOWLEDGE regarding normal nutrition and malnutrition is extremely important for the workers in the field of Child Health and Care, and it is of prime importance specially in the underdeveloped nations where malnutrition involves more than two-thirds of the population. It is a paradox that this subject is poorly understood by the basic doctors and health workers in these countries.

The author has rightly undertaken the task of simplifying this important aspect and propagate the knowledge to all those involved in Child Health Programmes. This comprehensive basic booklet is "the need of the day" for all the developing countries of the world. The author with his vast knowledge in the subject has planned the booklet in a very practical way. It covers up all the aspects of the problems related to nutrition. Simple methods for assessing the nutritional status of a child by medical and para-medical personnel have been discussed.

The book is a most useful one because it caters for the health workers in the underdeveloped countries and has considered the situations and requirements of those countries in a most practical way.

S. M. MERCHANT

*President,*

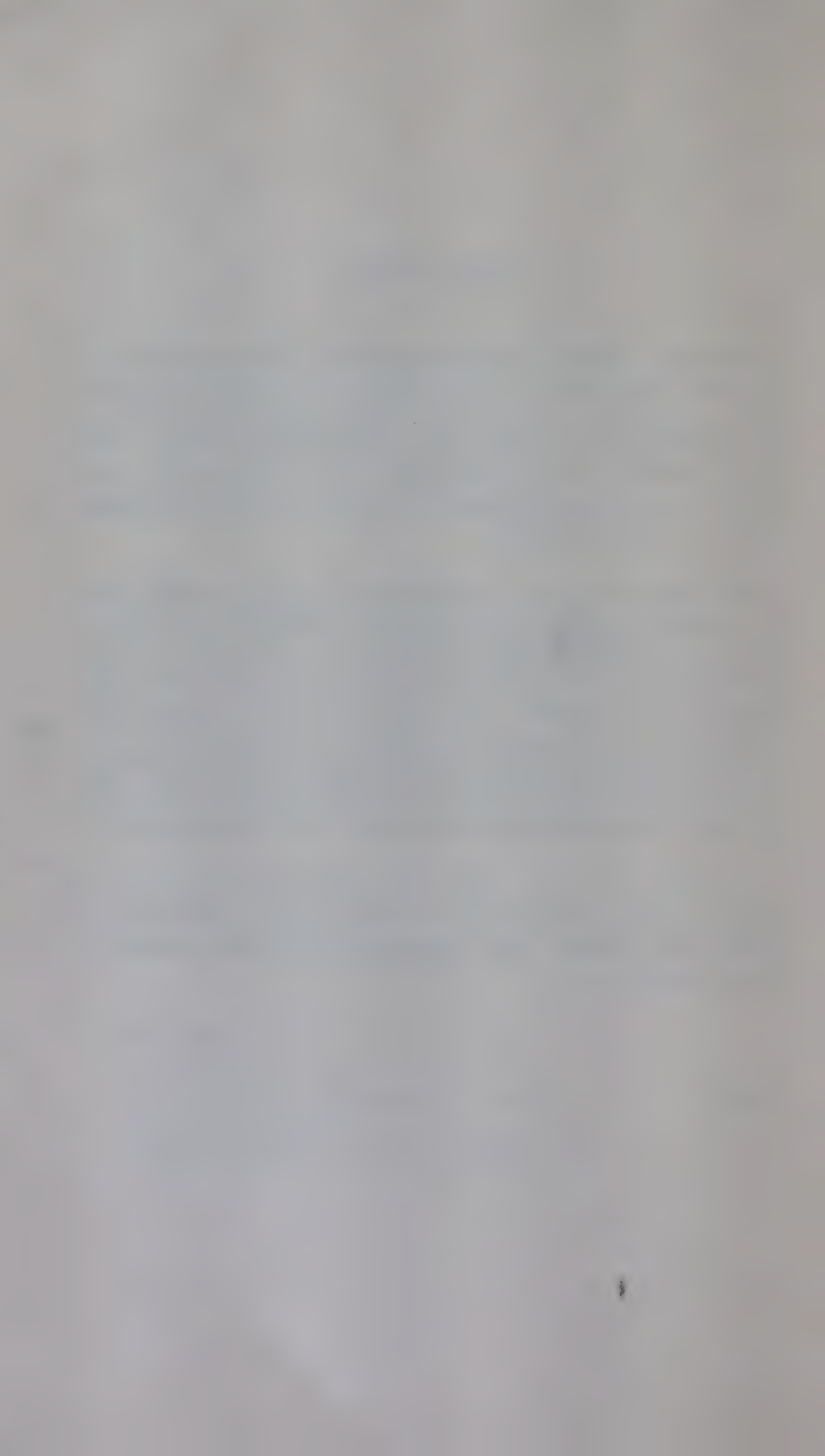
Indian Academy of Paediatrics, 1971

*Chief Paediatrician,*

B. J. Wadia Children's Hospital, Bombay

Bombay





## PREFACE

It is the experience of all the teachers in Paediatrics that the knowledge of an average basic doctor concerning the feeding of infants and pre-school children, and the early detection of malnutrition is extremely disappointing. A survey carried out by the Wadia Children's Hospital, Bombay, during 1971, revealed that only five per cent of the senior general practitioners, ten per cent of the junior practitioners and twenty-five per cent of the medical interns could give correct answers regarding the proper feeding and nutrition of infants and pre-school children. This means that something is basically wrong with our training of medical students in the subject of nutrition.

The mortality rate from severe malnutrition is high and recurrence is extremely common as after the discharge from hospitals the parents revert to the child's previous diet which the family socio-culturally and economically used to take. If we consider the period of one year from the day of hospitalisation, it has been observed that the overall mortality due to severe malnutrition varied between 60 and 80 per cent. At the same time a point prevalence i.e., prevalence at a given time, of malnutrition in pre-school children is above 80 per cent. To combat malnutrition is no doubt a stupendous task confronting the medical, nursing and paramedical personnel. It is seen that economic factors are the major contributors to the genesis of malnutrition. However, economic constraints are not the breaking points in successful prevention and management of malnutrition. Proteins, particularly from animal sources, have an important role to play in the prevention and management of malnutrition. However, in India the calories have a greater role. The problem is of quantity rather than of quality of diet alone and hence, expensive

animal proteins could be replaced by vegetable foods rich in both calories and proteins.

Through this booklet, an attempt has been made to describe briefly the various methods used to detect malnutrition in its early stages and to point out the important and practical tools like the weight charts and the QUAC-stick. The weight charts could be made available from a few selected sources. A copy of the QUAC-stick chart is given towards the end of this book which can be displayed in the clinic room of a practitioner. Various measures to prevent malnutrition are briefly discussed. Some of the common factors which lead to malnutrition in infants and pre-school children are emphatically brought out, with a view to emphasise that malnutrition should not be combated merely by nutritional measures. Many socio-economic, cultural, environmental and iatrogenic factors must also be taken into account.

This booklet is prepared primarily for a community doctor and medical students. It is, however, made simple and can also be useful for nursing and para-medical personnel and students in Nutrition Sciences. I earnestly hope that it will convey its message to all those who are concerned with the health and well being of children.

I am grateful to Dr. S. M. Merchant, President, Indian Academy of Pediatrics, 1971 for writing a Foreword to this book.

Let me express my gratitude to the Protein Foods Association of India, Bombay, and United States A.I.D., New Delhi for their financial grant in connection with the workshop on "Protein Calorie Malnutrition; Ecology and Management" held on 24th and 25th July, 1971 in Bombay. The workshop was organised by the Nutrition Sub-committee of Indian Academy of Paediatrics of which I had the privilege to be the Conve-nor. It was this workshop which inspired me to write this booklet.

I have referred to Dr. J. M. Bengoa, Chief, Nutrition, W.H.O., Geneva, Prof. D. B. Jelliffe, Professor of Paediatrics and Professor of Public Health, School of Public Health, University of California, Los Angeles, California, U.S.A. and Dr. David C. Morley, Reader, Institute of Child Health, London.



I express my very sincere thanks to them. I am obliged to Dr. G. K. Karandikar, Joint Director, Medical Education and Research, Maharashtra, Bombay, Miss Mandakini Khandekar, Associate in charge of the UNICEF sponsored Unit for "Study of Urban Child and Youth", Tata Institute of Social Sciences, Bombay, Mr. David P. Pyle, Administrator, CARE, Maharashtra, Bombay and to my wife Dr. (Mrs.) Kusum P. Shah, Reader in Obstetrics and Gynaecology, Grant Medical College, Bombay, for giving helpful suggestions on the text. My thanks are due to Dr. R. D. Lele, Dean, Grant Medical College, Bombay and to Dr. P. M. Udani, Director/Professor, Institute of Child Health, Grant Medical College and J. J. Group of Hospitals for their encouragement, to Mr. B. P. Mahale for the secretarial help and to Mr. C. B. Sankhala for preparing the diagrams.

10th May, 1973  
Suruchi,  
Nariman Point  
Bombay

P. M. SHAH



## CONTENTS

<i>Foreword</i>	7
-----------------	---

<i>Preface</i>	9
----------------	---

### SECTION I

Early Detection of Malnutrition	15
Magnitude of the Problem	15
Important Factors Leading to Malnutrition	16
Effective Ways of Early Detection	18
Clinical Methods	18
Anthropometric Methods	18
Weight	19
Weight Charts	21
Height; Weight/Height	28
Chest/Head Circumference Ratio	29
Weight/Head Circumference Ratio	29
Mid-arm Circumference	29
Subcutaneous Fat	30
Modified QUAC-Stick Method	30
Mid-arm/Head Circumference Ratio	30
Biochemical Tests	32

### SECTION II

Prevention of P.C.M.	33
----------------------	----

Feeding Problems	33
Promotion of Breast Feeding	33
Failure of Lactation	35
Cracked Nipples and Mastitis	36
Dilution of Milk and Preparation of Formulae	38
Humanised Milk Powders	38
Bottles and Teats	40
Weaning	42
Cheap Sources of Proteins and Calories	46
Consideration to Habits and Availability of Foods	48



Special Preparation of Foods for Infants and pre-School Children	49
Food Beliefs and Attitudes	49
Earning Mothers	50
Nutrition and Infectious Diseases	50
Diet During Illness	51
Diarrhoea and Malnutrition	53
Infestation and Prevention of Malnutrition	53
Planning of Families and Nutrition of Children	54
Prevention of Foetal Malnutrition	55
Preventing Malnutrition in School Children	55
Comprehensive Programme for Prevention of Malnutrition in the Community	56
Integrated Under-Fives' Clinics	56
Domiciliary Out-reach	57
Collaboration with Various Departments and Community Participation	60
Evaluation of Programmes	62

## APPENDICES

I Length/Height (in cms.) of Children under Six Years	64
II Chest Circumference (in cms) of Children under Six Years	65
III Head Circumference (in cms) of Children under Six Years	66
IV Arm Circumference (in cms) of Children under Six Years	68
V Local Events Calendar to Determine the Age	70

## SECTION I

### EARLY DETECTION OF MALNUTRITION

MALNUTRITION in its various forms is a very depressing health problem of to-day affecting over half of the world's population. Infants and pre-school children are the most critically affected. In India, 50 per cent of the pre-school children and 30 per cent of the school-age children have moderate to severe malnutrition. Protein calorie malnutrition is far more frequently seen as compared to its severe forms like marasmus or kwashiorkor. Malnutrition contributes directly or indirectly to high mortality and morbidity. It leads to retarded physical growth and may adversely affect the mental development. Today's malnourished children, if they survive to an adult age, will constitute a population segment having chronically ill health which, in turn, will seriously handicap the social and economic progress of developing countries. Instead of being an asset, they will be a liability.

#### *Magnitude of the Problem*

The prevalence of protein calorie malnutrition is extremely widespread in the community. However, very few frank cases of severe malnutrition are brought to the medical centres; those that are brought are mostly because of their association with other illnesses. The problem is well represented in Figure I which shows the "Malnutrition Iceberg", the major part of which is hidden underneath the deep sea of vast community. The majority of the children with mild and moderate malnutrition and even some suffering from severe malnutrition, remain undetected and are hidden underneath the 'Clinical Surface'. Many cases escape proper diagnosis primarily because of limited orientation and lack of awareness on the part of medical and paramedical workers to detect the early mild and moderate mal-

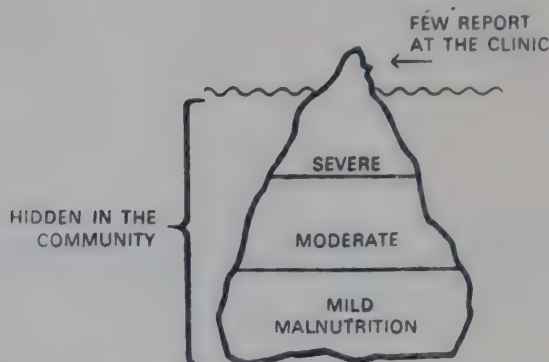


FIG. 1  
Malnutrition—Iceberg

nutrition lurking under cover of conditions like diarrhoea and upper respiratory infections. It is estimated that 80 per cent of the pre-school children in India suffer from varying degree of malnutrition. The magnitude of the problems could be assessed when the statistics are expressed in terms of absolute numbers. Children under five years of age constitute 17 per cent of the population in India, in other words, there are some 97 million pre-school children. This means that at any given time, 78 million children suffer from malnutrition and that about three to four million have a severe type of malnutrition. An average Primary Health Centre serves a population of about 80,000 including some 13,000 children under five years. Of these children, as many as 11,000 are likely to be malnourished and about 2,900 might be suffering from severe malnutrition.

### *Important factors leading to malnutrition*

The complexity of the problem of malnutrition becomes evident when socio-economic and environmental factors are taken into consideration.

*Poverty :* Although an average economically active worker earns about Rs. 1.20 per day, the average daily income per capita comes to only about Re. 0.27 in our country. A fair proportion of this income is spent towards fulfilling social obligations and formalities, repayment of loans or interest on debts and maintaining cancerous habits like alcoholism. How



ever, two-thirds of the income is spent on food which consists predominantly of cereals and to a less extent of pulses and leafy vegetables. Hardly 10 per cent of the expenditure on food is spent on foods from animal sources i.e., milk, egg and meat. The Poverty Index, when expressed in terms of deficient calorie intake, shows that 70 per cent of Indian population is at poverty level.

*Food habits and beliefs :* Even though two-thirds of India's population is non-vegetarian, only a few can afford to purchase meat or eggs regularly. Besides, many deep-rooted beliefs, customs, habits and attitudes very much guide the feeding of the infant and pre-school population.

*Family size :* Family size inversely affects the nutrition of a child. Some studies have revealed that the incidence of malnutrition is about twice among children of fourth and higher birth orders as among those with birth order of under four.

*Infections and infestations :* It is well documented that bacterial infections and parasitic infestations play their role in addition to the nutritional problems.

*Illiteracy :* There is also a very high illiteracy rate of 73 per cent which places a serious handicap in extending information and new ideas.

*Working mother and child care :* Quite a good proportion, 50 to 60 per cent, of the mothers of malnourished children are daily-wage earners, and the infant or pre-school child is looked after by an elder sister or a brother and is many a time, semi-starved.

*Health service and medical manpower :* On an average a sick child has to be taken to a distance of eight kilometres for medical relief. The rural community comprises 81 per cent of India's population and about half of that resides in small villages or hamlets with less than 1,000 population. The medical manpower available is limited. There is only one doctor for every 12,000 rural population and an Auxiliary Nurse Midwife (A.N.M.) for 10,000 rural population scattered over 7 — 8 villages. These medical persons are usually occupied in providing medical relief or cure and in most cases are unable to

spend the necessary time on the preventive and promotional health even for the most vulnerable groups of children.

*G.N.P. and health budget:* More than half of the country's population is economically dependent and requires special nutritional and health care. The proportionate increase in population exceeds the increase in per capita Gross National Product (G.N.P.). Due to the pressure for meeting other national needs the country's health budget is meagre. These facts are unlikely to change for better in the next few decades.

Hence, it is very vital to find out some ways to detect malnutrition in its very early stage so as to prevent or manage it even under the prevailing socio-economic and health set-up of a developing country.

## EFFECTIVE WAYS OF EARLY DETECTION

The majority of the malnourished children do not manifest florid signs and hence effective means of detection at an early stage is necessary to prevent children from going to severe grades of malnutrition like kwashiorkor or marasmus. There are a number of tests which help in early diagnosis. However, very few of these could be put into practice by medical personnel working in the field or even in their clinics. These are (i) Clinical; (ii) Anthropometric; and (iii) Biochemical methods to detect or assess malnutrition.

(i) *Clinical methods:* The World Health Organisation (W.H.O.) lists eleven clinical signs as being suggestive of protein calorie malnutrition. However, these signs are not always present in mild to moderate malnutrition. Also, the clinical methods of detecting early malnutrition are most variable, subjective and difficult to standardise. They require trained and paediatric nutrition-oriented medical persons to interpret them correctly. The clinical subjective impressions need to be confirmed by anthropometric measurements. Hence, it will be hard to diagnose a mild to moderate grade of protein calorie malnutrition by clinical methods alone.

(ii) *Anthropometric methods:* Since physiological changes take place first as compared to structural changes, the alteration in body measurements is not a very early manifestation of



malnutrition. The physiological alterations can be tested by biochemical tests which, however, have a number of limitations as mentioned below. The most affected structural change is in the fat and muscle mass which is reflected in terms of body weight, and arm and calf circumferences. In long-standing malnutrition other body measurements are also altered.

Knowledge regarding the age of a child is important while interpreting the anthropometric measurements. If age is not accurately known, it could be determined fairly correctly by using the local-events calendar. (Appendix V)

(a) *Weight*: This measurement is relatively easy to take and low weight or failure to gain weight gives an adequately reliable indication of nutritional status. The careful weighing of young children is the important method of recognising protein calorie malnutrition in its early stages. Useful information is gained by a single weighing, but serial measurements at intervals are always preferable as the latter provide a continuing picture of the medical progress or lack of it. The average weights of children at various age groups in our country are given in Table I. The way the Harvard standard was formulated was this: Weights of a very large number of children of both the sexes and of varying ages were recorded. A table showing the distribution of children by their sex, age and weights was prepared. The 50th percentile of this distribution was taken as the standard. Stated simply, the 50th percentile, in this case indicates the weight which exceeds that of 50 per cent of the children. Recent studies have shown that the 50th percentile of weights of Indian children from economically well-to-do families who have adequately favourable nutritional and social factors, are nearer to the 50th percentile of Harvard children. The Nutrition Sub-committee of the Indian Academy of Paediatrics has recommended that 50th percentile of the Harvard be taken as the reference standard for comparison. For comparison with the Harvard standard the age, sex and weight of a child are recorded. The Harvard standard tells us how much weight the child is expected to have according to his/her age. The actual weight is then expressed as a percentage of the expected weight. For example, a child of 21 months is expected to have a weight of 11.9



TABLE I

*Mean Weights and Heights of Average Indian Children*  
(I.C.M.R. Data)

Age	Boys		Girls	
	Weight in Kg.	Height in Cms.	Weight in Kg.	Height in Cms.
upto 3 months	4.5	56.2	4.2	55.0
4—6 months	6.7	62.7	5.6	60.9
7—9 months	6.9	64.9	6.2	64.4
10—12 months	7.4	69.5	6.6	66.7
1 Year	8.4	73.9	7.8	72.5
2 Years	10.1	81.6	9.6	80.1
3 Years	11.8	88.6	11.2	87.2
4 Years	13.5	96.0	12.9	94.5
5 Years	14.8	102.1	14.5	101.4
6 Years	16.3	108.9	16.0	107.4
7 Years	18.0	113.9	17.6	112.8
8 Years	19.7	119.3	19.4	118.2
9 Years	21.5	123.7	21.3	122.9
10 Years	23.5	128.4	23.6	128.4
11 Years	25.9	133.3	26.4	133.6
12 Years	28.5	138.3	29.8	139.2

TABLE II

*Grades of Protein Calorie Malnutrition*  
(Nutrition Sub-committee, Indian Academy of Paediatrics)

Grades	Percentage Weight of the Reference Standard (Harvard)
I	71 — 80%
II	61 — 70%
III	51 — 60%
IV	50% and below

“K” in front of a grade denotes kwashiorkor.

Kgs., but if its weight is only 10.1 Kgs., then we will say that its weight is 85 per cent of the standard weight. This percentage is then used to indicate the nutritional status of a child. According to the Nutrition Sub-committee of the Indian Academy of Paediatrics, protein caloric malnutrition has been classified into four grades. (Table II). This classification is simple and as it utilises the International Harvard Standard for comparison (Table III) it is fairly comparable elsewhere. The cases having oedema, which is suggestive of Kwashiorkor, are denoted by 'K' in front of their grades. It means that children in grade III and IV who have oedema and expressed as grade III K or grade IV K are the cases of marasmic kwashiorkor while a case in grade I K denotes 'Sugar baby' kwashiorkor. The terms "Marasmic" or "Sugar baby" need not be used when a child is graded as per weight and oedema.

The weight gain during the first year is the highest gain in life. During first month a child gains about 0.750 Kg. (24 Ounces) and during 2nd and 3rd months gains on an average of 0.700 Kg. per month, and hence by three months he will put on a weight of about 2.0 — 2.250 Kgs. A normal newborn baby weighing about 3 Kg. at birth doubles his weight by five months and trebles it by the first year. This doubling and trebling varies depending on the birth weight. Hence, a baby weighing 1.5 Kg. at birth doubles his birth weight by three months and trebles it by 5 — 6 months and quadruples by 8 — 9 months.

(b) *Weight charts*: The early detection of malnutrition is possible if serial weights are taken at regular intervals and plotted in a graph form as shown in the weight charts (Figures IIa & b). These weight charts have two curves; the top is based on the mean weights of children living under good conditions and had optimum opportunities to grow, while the lower line represents the mean weights of children, majority of whom come from lower socio-economic conditions and are not so fortunate. The 50th percentile of the Harvard standard weights is referred in the top curve and the 50th percentile of the Indian Council of Medical Research weights, which are weights of average Indian children, is taken for the lower line. The direction of the weight curve of the child is of the greatest

TABLE III

## Percentage of the Standard of Reference Weight

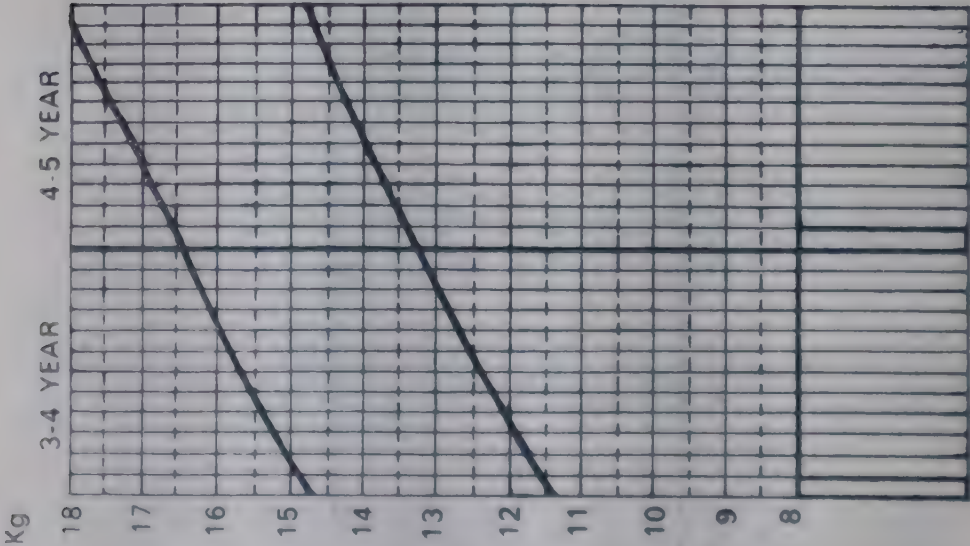
(Weight in Kgs.)

Age in Months	Harvard Standard	Percentage of the Standard									
		95	90	85	80	75	70	65	60	55	50
3	5.7	5.4	5.1	4.8	4.5	4.2	4.0	3.7	3.4	3.1	2.8
6	7.4	7.1	6.7	6.3	5.9	5.5	5.2	4.9	4.5	4.1	3.7
9	8.8	8.4	8.0	7.5	7.1	6.5	6.2	5.8	5.3	4.9	4.4
12	9.9	9.4	8.9	8.4	7.9	7.5	6.9	6.4	6.0	5.5	4.9
15	10.6	10.0	9.5	9.0	8.5	7.9	7.4	6.9	6.4	5.8	5.3
18	11.3	10.7	10.1	9.6	9.0	8.5	7.9	7.3	6.8	6.2	5.6
21	11.9	11.3	10.7	10.1	9.6	8.9	8.3	7.7	7.2	6.5	5.9
24	12.4	11.7	11.2	10.5	9.9	9.3	8.7	8.1	7.5	6.8	6.2
27	12.9	12.2	11.8	11.0	10.5	9.7	9.2	8.4	7.8	7.1	6.4
30	13.5	12.8	12.2	11.5	10.8	10.1	9.5	8.8	8.1	7.5	6.7
33	14.0	13.3	12.6	11.9	11.2	10.5	9.9	9.1	8.4	7.7	7.0



36	14.5	13.8	13.1	12.3	11.6	10.9	10.2	9.4	8.7	8.0	7.2
39	15.0	14.2	13.5	12.7	12.0	11.2	10.5	9.7	9.0	8.2	7.5
42	15.5	14.7	13.9	13.3	12.4	11.6	10.8	10.1	9.3	8.5	7.7
45	16.0	15.2	14.4	13.6	12.8	12.0	11.2	10.4	9.6	8.8	8.0
48	16.5	15.7	14.8	14.0	13.2	12.4	11.5	10.7	9.9	9.1	8.2
51	17.0	16.1	15.3	14.4	13.6	12.7	11.9	11.0	10.2	9.3	8.5
54	17.4	16.5	15.7	14.8	14.0	13.0	12.2	11.3	10.5	9.6	8.7
57	17.9	17.0	16.1	15.2	14.4	13.4	12.6	11.6	10.7	9.8	8.8
60	18.4	17.4	16.5	15.6	14.7	13.8	12.9	12.0	11.0	10.1	9.2
<i>Boys</i>											
66	20.7	19.7	18.6	17.7	16.7	15.7	14.6	13.4	12.4	11.3	10.3
72	21.9	20.8	19.7	18.6	17.5	16.4	15.3	14.2	13.1	12.0	10.9
<i>Girls</i>											
66	20.0	19.0	18.0	17.0	16.0	15.0	14.0	13.0	12.0	11.0	10.0
72	21.1	20.0	19.0	17.9	15.8	15.8	14.8	13.7	12.7	11.6	10.5

UNDER-FIVE'S CLINIC



CLINIC	CHILD'S NO
CHILD'S NAME	
MOTHER'S NAME	REGISTRATION NO.
FATHER'S NAME	REGISTRATION NO.
DATE FIRST SEEN	BIRTH DATE
ADDRESS	

BROTHERS AND SISTERS

YEAR OF BIRTH	BOY/GIRL	REMARKS

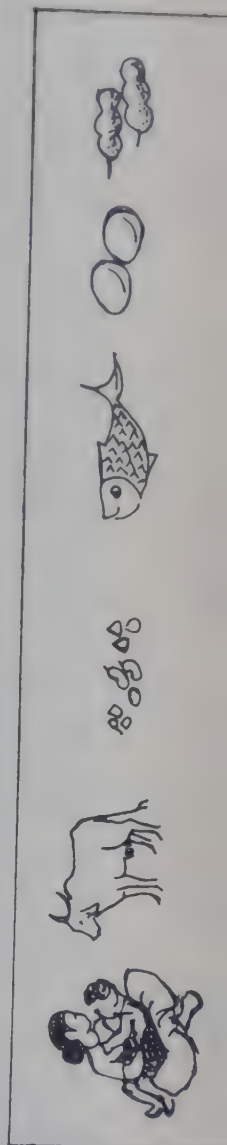
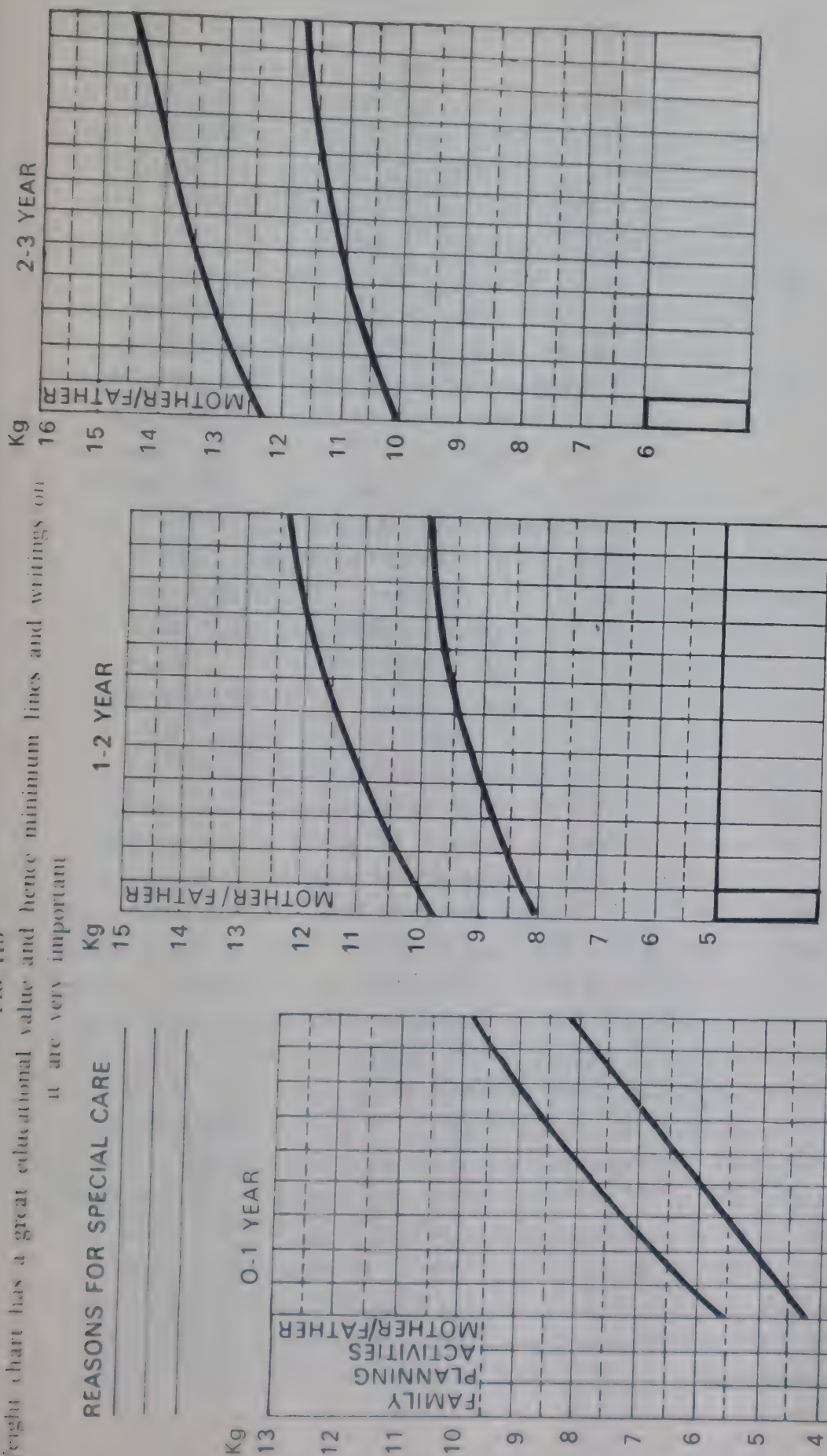
ANTI-TUBERCULOSIS IMMUNISATION (B.C.G.)	DATE OF IMMUNISATION
SMALL-POX	
DATE OF IMMUNISATION	
DATE OF SCAR INSPECTION	
DATE OF RE-IMMUNISATION	
POLIOMYELITIS IMMUNISATION	
DATE OF FIRST DOSE	
DATE OF SECOND DOSE	
DATE OF THIRD DOSE	
DATE OF BOOSTER 1	2
WHOOPING COUGH, TETANUS & DIPHTHERIA IMMUNISATION (TRIPLE)	
DATE OF FIRST INJECTION	
DATE OF SECOND INJECTION	
DATE OF BOOSTER 1	2
TYPHOID IMMUNISATION (T.A.B.)	1 2 3 4

FIG. IIa  
Weight chart for under-fives, simplified record of growth

Weight chart has a great educational value and hence minimum lines and writings on it are very important

### REASONS FOR SPECIAL CARE

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_





significance in interpreting the growth of a child. If a child's weight curve goes parallel to the curves or has an upward trend, it denotes a satisfactory growth. If the line is static or there is a downward trend, it indicates that the child is facing slowing or retardation of growth, in all probability, due to nutritional deficiency. An infant, as shown in Figure III, was growing very well while he was on mother's milk. The mother stopped feeding on account of her illness and he was put on diluted cow's milk formula. From 4th month to 7th month, he gained only 0.200 Kg. If his weight is seen for the first time at 7th month, it falls within the normal mean range. However, serial weights denote serious slowing of the growth. Hence, the actual position of any one weight recording on the chart is of less importance than the direction in which the weight curve of the child is moving. This enables very early detection of malnutrition. The space between two weight curves is described as the 'Road to Health' and has a great educational value to the mother. The cards are of 26.0x21.6 cms. size and are kept in polythene cover with the mother. The mother is initially told about the "Road to Health" and is taught to interpret the trend in the movements of the line showing the actual weight of her child. The upward trend gives her satisfaction and she feels proud of her child's achievements in terms of growth, while a flattened or a downward trend becomes a matter of great concern which depresses the mother. The disappointed mother, in most cases, will consult the health worker for her help in restoration of the health of her child. For the health worker, it is an indication of the need for a talk and advice to the mother about proper feeding habits through nutrition education, demonstrations and by giving examples of her neighbours' healthy children of the same age and their feeding habits. It also alerts the health worker that the child requires a special supervision at the clinic and through home visits, and for supply of supplementary feeds. If weight taken at regular and frequent intervals shows a continuous downward trend of the curve for about two months despite the mother's attempts to modify the diet as advised, the health worker should then at once refer the case to a doctor for early diagnosis of some disease which otherwise would have clinically manifested after a few months.

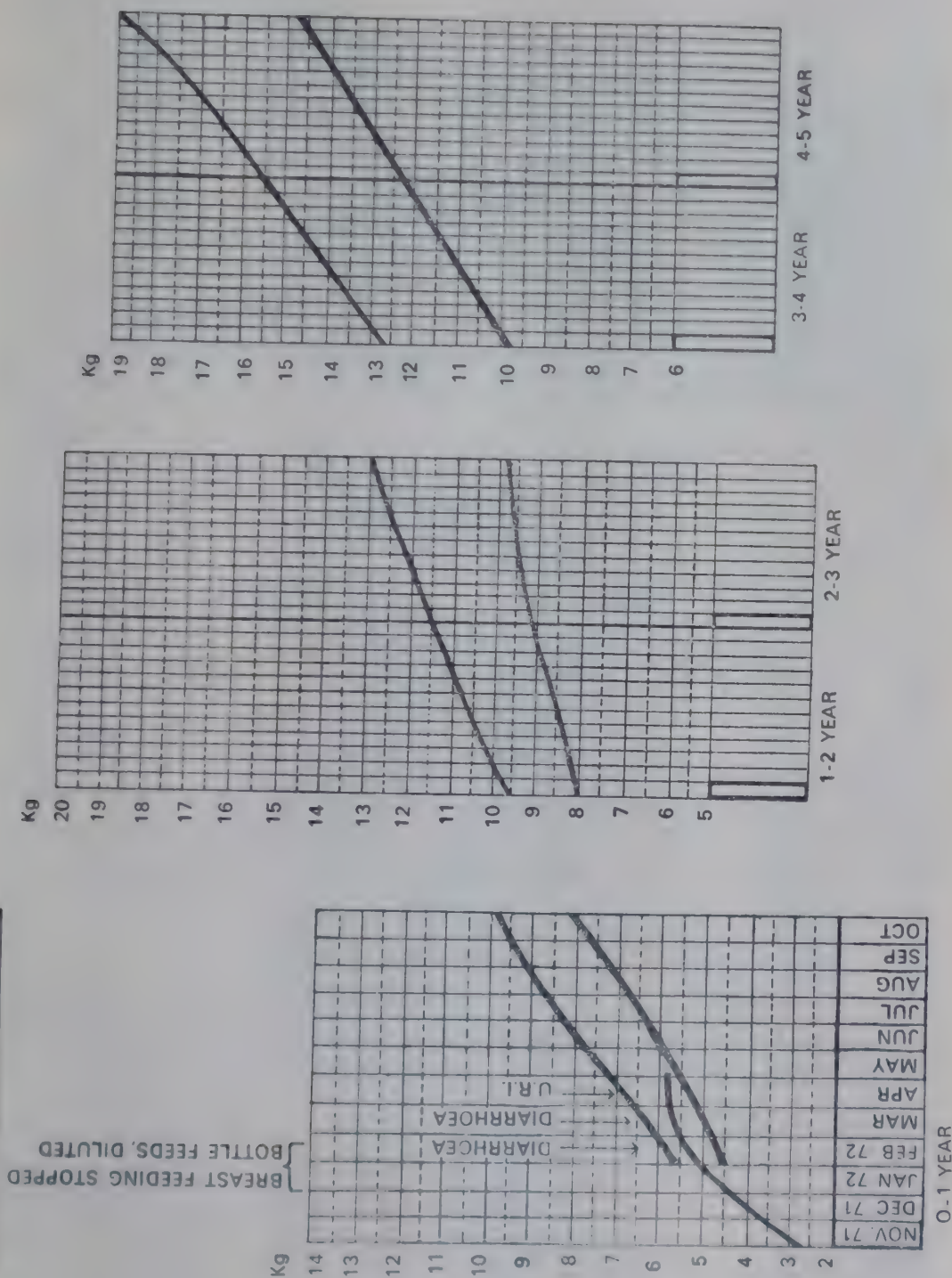


FIG. III  
 Effect of illnesses and feeding on the weight curves; Early detection of faltering of growth



The filling in of this chart is simple but requires some orientation in registering the month of birth, entering the weight point on the graph at the proper place, drawing the line, making entries of illnesses, feeding, deworming and immunisations. Once the month of birth and the subsequent calendar has been correctly filled in, the child's age need not be calculated during his further visits.

Serial weighing at regular intervals and recording in the weight chart is an excellent way of early detection of malnutrition as it is based on the experience that the child who continues to grow adequately never develops malnutrition. However, this involves regular weight-taking which may be a difficult proposition as the mother is occupied in her daily household chores and may not be in a position to bring to the clinic the child who is otherwise apparently healthy. In such a situation, there should be some system by which the weight of the child can be taken at home. The weighing scale shown in Pl. 1 gives a fairly accurate reading and is conveniently portable for domiciliary services. This scale can be hung on any beam in a room or a branch of a tree. The swing seat made out of cloth or canvas can be used to hold a child under five years. Children weighing less than 25 Kg. can be weighed on this scale. This scale with a swing seat costs less than Rs. 250. The practice of weighing serially and at home may be cumbersome, but this is the only practical and probably the best way of detecting growth failure and early malnutrition. For maintaining proper weight charts, age of a child should be known exactly in months and sometimes a calendar of local events should be prepared and consulted to determine as exact an age as possible.

The graphic weight record through a weight chart has now been recommended by the W.H.O. for use of children of 0 — 5 years. Many of the developing countries of the world have adopted these weight charts. In India a few States have made a beginning and shortly these charts will be available in all the regional languages.

(c) *Height; Weight/Height*: The height or length is not greatly affected by mild malnutrition. The changes in height are observed in prolonged malnutrition. Hence, this cannot



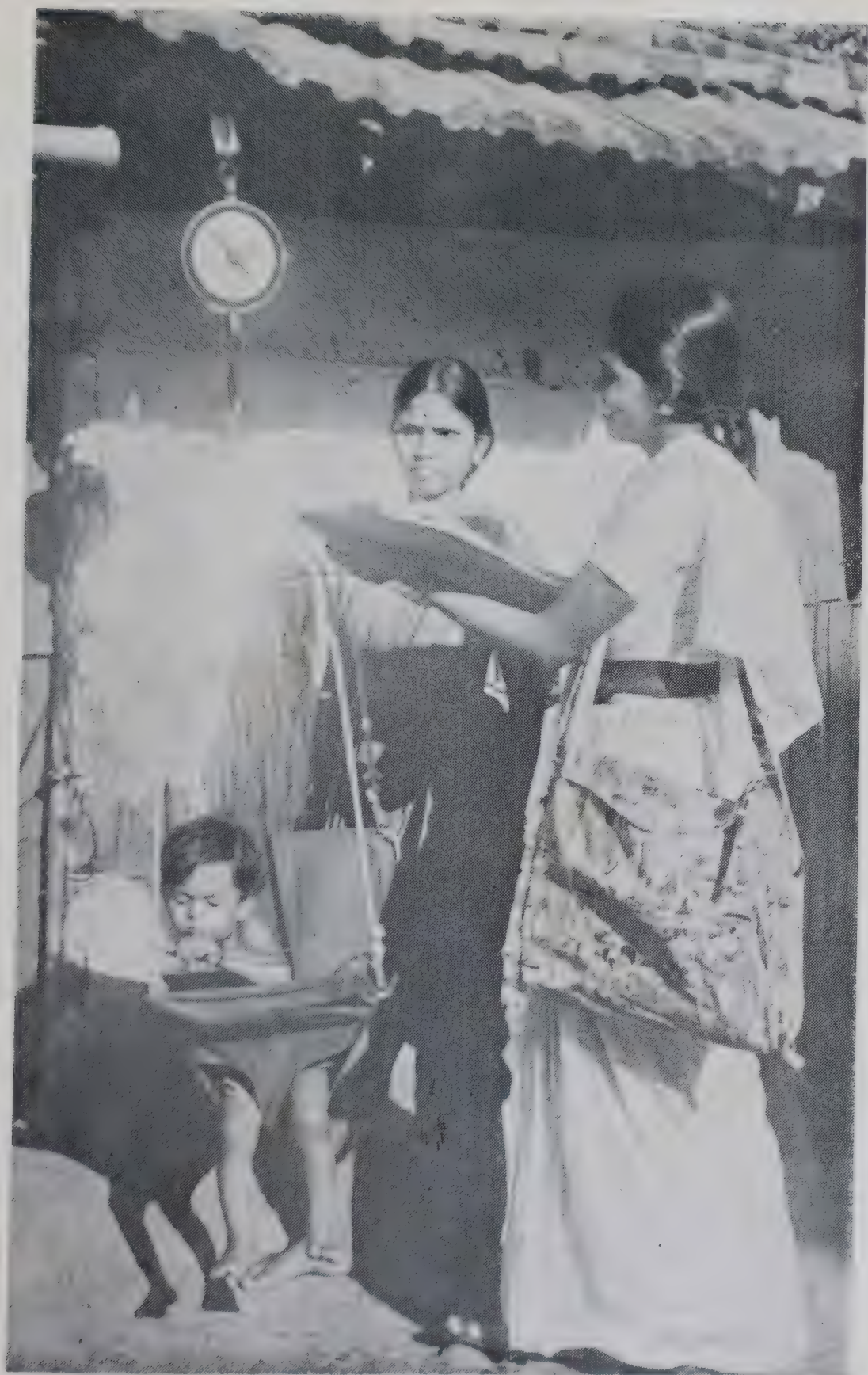


PLATE 1: Weighing scale and swing seat are conveniently portable for domiciliary services.

PLATE 2: Maximum left arm circumference is fairly reliable method to assess the nutritional status of the under-five.

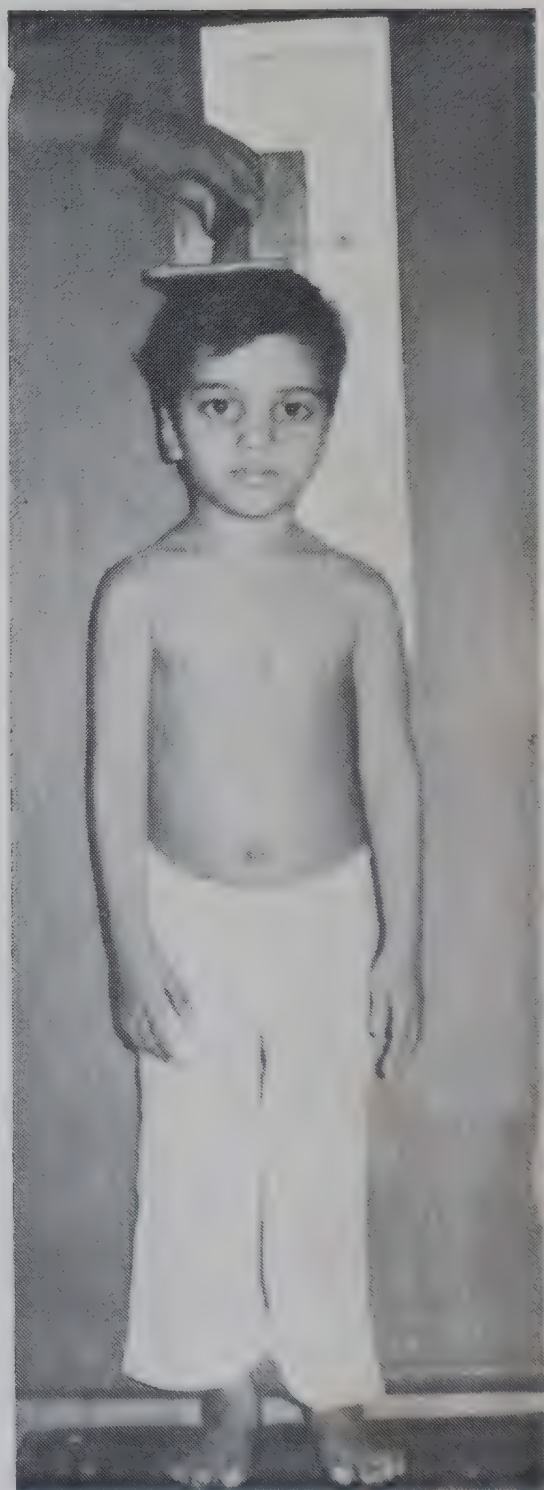
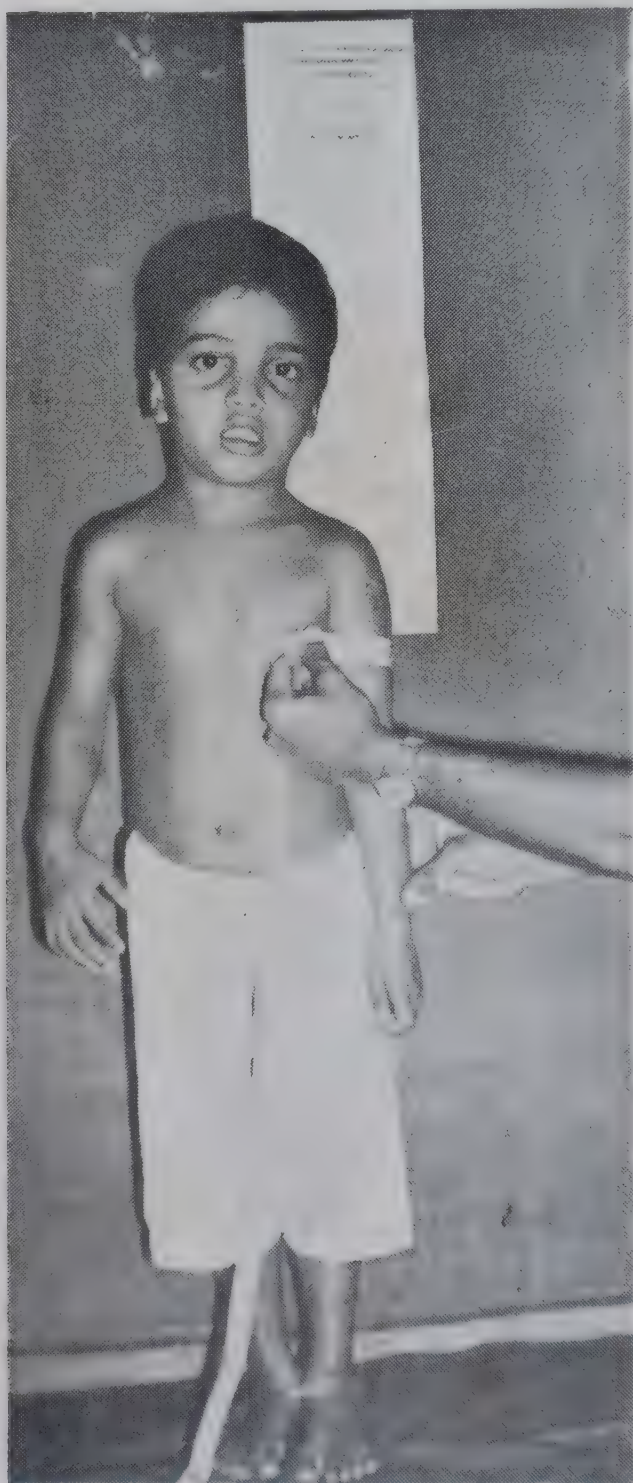


PLATE 3: In front of figures for height and arm circumference, nutritional status of a child could be read out from the figures given on the QUAC-stick paper.



be utilised as a tool to detect early malnutrition. Considering that height is least affected in acute malnutrition this is used as a comparative measurement for other parameters like weight, and weight-height ratio has been considered for detecting malnutrition. The average height/length of the Indian children is given in Table I.

(d) *Chest Head circumference ratio* : In a new-born child circumference of head is greater than circumference of chest. This becomes equal in case of healthy infant by nine months to twelve months. In malnourished children where physical growth is retarded, the head continues to remain bigger upto 30 — 38 months. This ratio cannot be of much help in detecting early malnutrition.

(e) *Weight Head circumference ratio* : This ratio is based on the findings that in malnutrition of recent origin the circumference of head is not altered and at any given time weight/head circumference ratio reflects the changes in the weight. This ratio is useful especially if a child's age is not known. However, the ratio needs to be calculated upto a few decimal points and a reference has to be made to a table which may be a cumbersome procedure for the field workers.

(f) *Mid-arm circumference* : Between second and fifth year of life, the arm circumference remains more or less constant, varying from 16.25 to 16.75 cms. This is due to the fact that the fat of infancy gets replaced by muscles with the overall circumference remaining the same. For detecting an early P. C. M. when age is not known exactly, the arm circumference can give a fairly reliable assessment of nutritional status as muscles and fat deficit is a constant clinical feature in malnutrition. This measurement can be expressed as a percentage of the average mid-arm circumference mentioned above and can indicate the nutritional status of a child with reference to standard weight. Children with measurements below 80 per cent of the average i.e., those having measurement of 12.8 cms., are malnourished. It is now recognised that maximum arm circumference taken when the left arm is hanging by the side of trunk is about the same as the mid-arm circumference. (Pl. 2)

Various percentages of the international norms for height



and circumferences of head, chest and arm are given in the Appendices I to IV.

(g) *Subcutaneous fat* : Measurement of subcutaneous fat at mid-triceps is one of the reliable methods of assessing the nutritional status of an under-five child. However, that requires an expensive caliper and there are associated errors in measurements.

(h) *Modified QUAC-stick method* : A strip of paper (Fig. IV) mentioning the height in cms., figures of arm circumference and against that the percentage mentioning nutritional status can be used either against a wall or a stick which can be fixed in the ground anywhere. In practice, the maximum left arm circumference when the arm is hanging by the side of trunk is taken and then the child stands in front of this QUAC-stick paper where height is measured (Pl. 3). In front of the figures for height and circumference of arm, on those lines on the modified QUAC-stick paper, the nutritional status of a child could be read out in terms of percentage of the expected. For example, if a child's actual height is below the level of the circumference of his arm, then his arm circumference is more than 80 per cent and the child is in normal range and he is not malnourished. Conversely, if he is taller than the level on the stick at which his measured arm circumference is found, his arm is thinner than that of the average child of his height and he is malnourished.

This is a very simple, fairly reliable, inexpensive and objective method to detect malnutrition of acute onset and it is very easy to learn and could be carried out by non-medical persons as well. It is easy to interpret and is independent of the knowledge of correct age. This gives a fairly good assessment of the nutritional status and is most useful for children having acute malnutrition following floods, wars or other natural calamities. It was used originally by the Quaker team in Nigeria (Quaker Arm Circumference measuring stick). The QUAC-stick has been modified for India and it has been found to be a fairly reliable method for detecting early malnutrition.

(i) *Mid-arm/Head circumference ratio* : This ratio is used by some of the workers for detecting malnutrition as it is not much affected by age and sex and there is no need to refer to

## QUAC -STICK MODIFIED FOR INDIAN CHILDREN

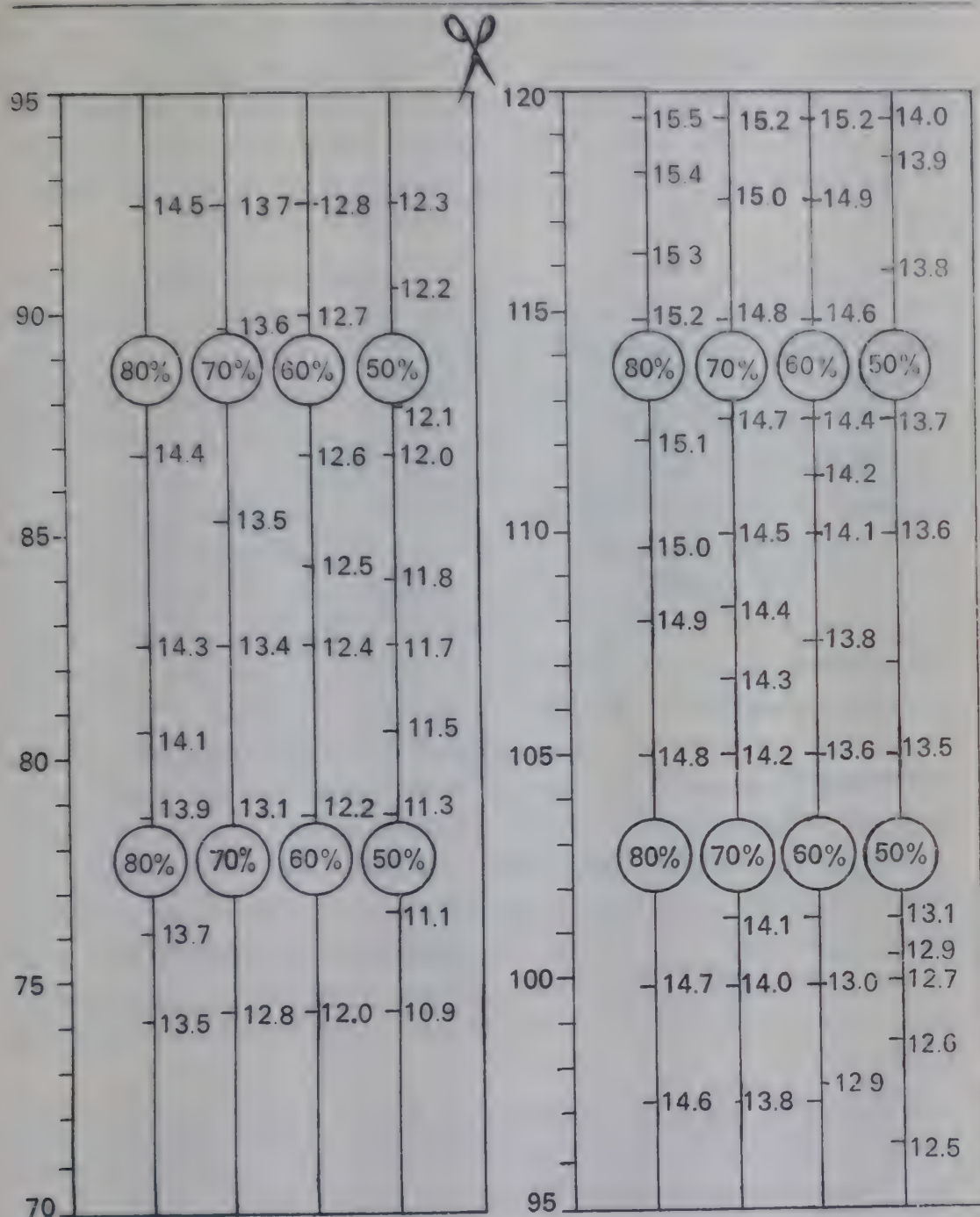


FIG. IV

QUAC—stick modified for Indian children

any International or local standard. However, like Weight/Head circumference ratio, it involves calculations and reference to a complex table.

The anthropometric tests are probably the most practical



tools for detecting early malnutrition. They require very simple apparatus and can very easily be carried out and do not create any antagonism in the minds of parents as seen against collection of blood samples. The most practical of these are weight charts and QUAC-stick for early detection of malnutrition either at a clinic, hospital or in the community itself.

(iii) *Biochemical tests*: All the biochemical tests for detection of malnutrition are based on the alterations which take place in protein metabolism and hence value of these tests is limited to extreme cases of protein malnutrition like kwashiorkor and are not of much significance in marasmus and intermediary malnutrition. Just to enumerate, these investigations are (a) serum albumin; (b) non-essential/essential amino acids ratios in urine and serum; (c) hydroxyproline excretion in urine; (d) urinary creatinine/height ratio; (e) urinary urea/creatinine ratio; (f) serum transferrin, and many others. These tests reflect on the stores of proteins in muscles and elsewhere, on their metabolism in liver and their transport. No matter how academic these tests may appear, there is hardly any reliable biochemical test which can easily be taken up for early detection of malnutrition. Moreover, these investigations are influenced by factors like age, associated infections, and timing and type of meal taken prior to the test. The major difficulty with these tests is the need for expensive equipment and skilled laboratory personnel. For a doctor working in a community, these are, therefore, not of much significance or practical utility.

The florid signs of marasmus and kwashiorkor are well known. However, it is a pity that these are at times treated for rickets or nephrosis. Hence, taking of weight is extremely important in children under five years of age for correct and early diagnosis of malnutrition.



## SECTION II

### PREVENTION OF P. C. M.

A CHILD with proper feeding and adequate nutrition has a satisfactory growth and if he has been protected from infectious diseases, helminths and attacks of diarrhoea, he will be in sound health and generally speaking may not require a doctor for his minor ailments. Hence, the sheet anchor of good health is proper nutrition. Good nutrition is not synonymous with expensive items of food. It means adequate amount of calories, proteins and other proximal principles of food.

It is the children under five years of age among whom prevention of malnutrition is most rewarding in bringing down morbidity and mortality rates. One of the major socio-economic and environmental factors which leads to malnutrition is the ignorance of parents about the correct feeding of their infants and pre-school children and hence, proper advice on nutrition can change the nutritional status and growth of a good proportion of these children.

#### FEEDING PROBLEMS

There are a number of feeding errors and problems which have not received proper attention of the medical and paramedical personnel and hence it is worthwhile to mention these factors in brief.

##### *Promotion of Breast feeding*

For all mammalian infants no food is superior to their mother's milk and hence by nature's law which is well confirmed by biochemical and a number of other observations that all the newborns should be kept on mothers' milk within a few hours after birth. Breast feeding can be con-

tinued even up to one and half years, besides timely introduction of semi-solids and solids. Prolonged breast feeding has practical and historical support in India. The majority of mothers breastfeed their babies. Due to illness or some operative interference with a mother, if the infant could not be put on breast, it should be given mother's expressed milk. It is imperative to see that the mother's breasts are well expressed to reduce intramammary tension for continuation of lactation. If this minor point is not kept in mind which happens many a time as the medical efforts are concentrated more on the sick or operated mother than on the baby and breast feeding, to the effect that the mother experiences breast engorgement, nipple pain and discomfort which in turn prompts the doctor to start oestrogen preparations to suppress the lactation. This decision on the part of a medical person can have serious effect on the innocent baby from lower or middle economic strata, who in all probability will be put on a diluted formula given in a contaminated bottle. If medical and paramedical personnel are vigilant while advising how a newborn should be fed when his mother has been operated upon or is ill or experiences a failure of lactation, a great part of the problem of marasmus in a community will be solved. Generally speaking, there are no absolute indications for discontinuing breast feeding. The age-old notion that a mother's milk is contraindicated if she is an open case of tuberculosis or having leprosy is illogical and does not consider the realities of situations in those families. By stopping breast-feeds one cannot nullify the possibility of spreading the infection from mother to baby as it is this mother who will be in contact with the baby both day and night, in that small one-room tenement or hutment. It may be brought out here that 88 per cent of the population in the city of Bombay resides either in hutments or in one-room tenements. Thus continuous contact between mother and infant is unavoidable, they are inseparable. Moreover, by advising artificial feeds, one drags these infants into repeated gastro-enteritis and marasmus through contaminated feeding bottles filled with overdiluted milk. In case the mother is tubercular, the baby should be put on Isoniazid prophylaxis of 10 mg/kg body weight per day until



she becomes non-infective. This is a relatively short period and it is safe to discontinue Isoniazid prophylaxis when the child is three months old. In the case of leprosy, a sufficient amount of sulphone is excreted into the milk, when the mother is on treatment, to protect the infant.,

### *Failure of Lactation*

Failure of lactation or poor lactation is one of the major contributory factors leading to malnutrition. The commonest causes of the failure of lactation are (i) psychological factors and (ii) local conditions of breasts.

(i) *Psychological factors*: Mothers with psychological disturbances, if asked why they put the baby on other milk, will always answer that breast milk was not sufficient. They on their own, are unable to understand the relationship between psychological disturbances and lactation failure. Very young, elderly primipara, those who have given birth to daughters in succession, mothers with high education or working mothers are those who are likely to experience lactation failure due to emotional upsets and other psychological factors.

(ii) *Local conditions of breasts*: (a) Retracted/inverted/flat nipple: Sometimes local causes like retracted, inverted or flat nipples are contributors to difficult breast feeding and consequently the babies are kept on artificial feeds and end up with marasmus and gastro-enteritis. In these conditions, an infant tries to suck but cannot get milk as the nipple is inverted or retracted. Here, the knowledge of understanding of the process of sucking may help. While sucking, the tongue passes underneath the nipple and draws it forward into the cavity of the mouth towards the back of the palate. The ability of the nipple to be protracted in this way is essential to the sucking process. Gums press on the lacteal sinuses—lakes of milk—which lie underneath the areola (Fig. V). It is important to realize that sucking plays a small part in the actual obtaining of the milk from the mother's breast. The milk is obtained by combination of the let down reflex in the mother's breast and the action of the infant's gums on the lacteal sinuses. Due to retracted, inverted or flat nipple, an



infant cannot suck properly (Fig. VI and Pl. 4 & 5) which leads to improper emptying of the breasts. The baby gets only a small amount of milk but is exhausted and falls asleep. After a short time it cries with hunger. This happens frequently and the mother, and many a time mother-in-law or relatives attribute the crying of the child to abdominal colic or consider that her milk is not sufficient or does not suit the child and advise hazardous reconstituted milk feeding. The prime cause, the retracted or inverted nipple, could be prevented during the antenatal and postnatal periods by advising the mother to massage the breasts from the ribs towards the front and bring out the nipple. The method of obtaining milk from a breast by using a breast-pump was most ineffective as it applies only suction.

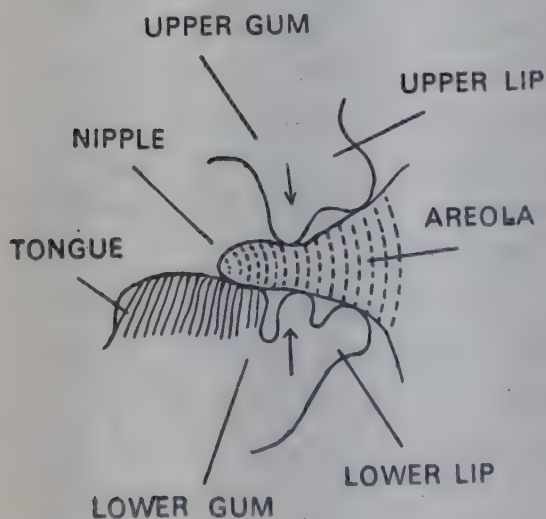


FIG. V  
Suckling Process

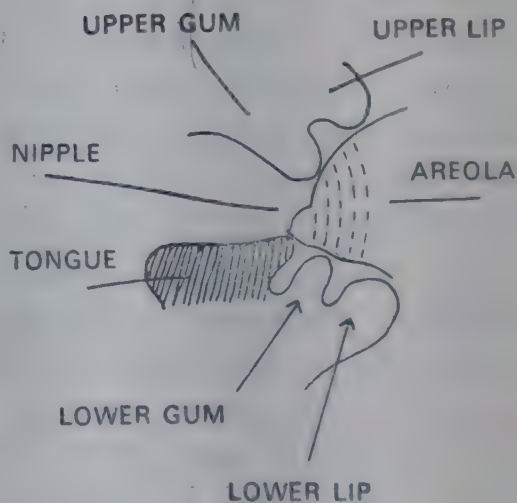


FIG. VI  
Retracted Nipple and Suckling

(Reproduced by courtesy of Lloyd-Luke Ltd., London)

(b) *Cracked Nipples and Mastitis*: Most mothers experience some discomfort when a baby first begins to nurse. This usually disappears as milk secretion increases and ejection reflex permits quick release of milk. If the reflex does not function well, pain may persist. Vigorous sucking by the hungry, frustrated infant who bites the nipple with gums, which results in a painful, sore or cracked nipple. Organisms colonise on the sore nipple and in the presence of milk which is a favourable



PLATE 4: Marasmic infant who could not gain in weight since its birth.  
The mother had retracted nipples and very poor lactation.



PLATE 5: Inverted nipples led to failure of breast feeding and severe malnutrition in the infant.





PLATE 6: Grandmother feeding her grandson, twenty-five years after her last delivery. Amount of milk secreted 70 ml./day.



PLATE 7: Plastic overlay stencil; a quick and simple method to assess the grade of malnutrition.



medium. they multiply and cause mastitis which is a very painful condition. Hence, the breasts are not fully emptied and there is retention and engorgement. Such breasts are to be treated with antibiotics and bland lanolin application locally after each feeding. The baby should be nourished first on the unaffected or less affected breast permitting adequate time for nourishing. The milk may be expressed from the affected breast by that time as the let down reflex is well set up.

It is imperative to examine the breasts of (i) primipara mother during antenatal period; (ii) those mothers with a past history of failing lactation; (iii) mothers who have a marasmic infant under six months who is brought for treatment for other conditions; and (iv) mothers who have a recent cessation of lactation.

Many a time due to lactation failure, infants are brought with complaints of sleeplessness and incessant crying. This is due to the fact that they are on starvation, feedings of little breast milk or of excessively diluted formula. If the mother is given a well detailed explanation of the sucking process, she can gain confidence in breast feeding and when the infant is put to the breast again, there are chances that lactation will increase greatly or even start again. At times tranquilizers given to the mother will have an added effect. There is an example of a grandmother being able to restart lactation for the grandchild twenty-five years after her last delivery (Pl. 6). Pre-term babies who cannot suckle, should be given expressed breast milk rather than artificial milk. The hospital procedure of keeping pre-term babies on artificial feeding without expressing mother's milk can be ultimately detrimental and even fatal to these babies as many of the mothers cannot carry out that feeding schedule satisfactorily at home due to economic factors. Many of them lack the hygienic training required for sterilising the bottle and teat.

Some of the younger mothers in towns and cities hear through advertisements about good results claimed by feeding of artificial milk powers. At times she is impressed by the excellent growth of some babies from economically well-to-do families who are on milk powders and proper weaning but she attributes satisfactory growth only to humanised milk

powders. This trend of shifting over to artificial milk powders by mothers of lower and middle economic groups in cities and towns is dangerous and should be discouraged as it leads to malnutrition and even increases morbidity as there is a greater possibility of contamination creeping in.

### *Dilution of Milk and Preparation of Formulae*

It is surprising that many medical personnel are ignorant about the proper dilution of milk formula to be given at various ages during infancy. Sometimes mothers are advised to put the infants on diluted milk during an attack of diarrhoea and these feeds unfortunately continue later on for months together as the prescribing doctor has failed to communicate to the mother how long that diluted formula should be continued. The dilution of milk to be given during the first six months of life is mentioned in Table IV. The table also indicates the amount of sugar to be added to each formula, and the amount and number of feeds an infant may take at different ages. The dilution may continue for a shorter or a longer duration depending upon the individual infant's adjustability and growth. Hence, one should not wonder when some babies do very well on undiluted cow's milk even from their neonatal period or undiluted buffalo's milk quite early in infancy. The mother's impression that the child does not tolerate undiluted formula or some particular dilution, and gets diarrhoea is ill-conceived. Generally, diarrhoea is mostly due to the introduction of infection through the bottle or teat. However, if not advised properly a mother or a grandmother will further dilute the milk. There are instances where a child used to get eight to ten times diluted milk, which was just white-coloured water. Proper advice on preparation of formula and hygiene of bottle feeding are of great importance in preventing malnutrition in infants who are on supplementary feedings.

### *Humanised Milk Powders*

There is an encouraging trend in some of the developing countries not to advise the use of humanised milk powders or



TABLE IV

*Preparation of Formula with Cow's Milk or 'Toned' Milk*

<i>Age of infant</i>	<i>Milk proportion</i>	<i>Water proportion</i>	<i>One tea-spoon of sugar to a formula of</i>	<i>Approx. oz. per feed and number of feeds per day</i>
Birth to 2 weeks	1	I	3 oz.	2-3 oz.; 6-7 times
2 weeks to 2 months	2	I	3 oz.	2-4 oz.; 6 times
2 months to 4 months	3	I	4 oz.	4-5 oz.; 5 times
Beyond 4 months	Undiluted	—	4 oz.	5-8 oz.; 4-5 times

*Dilution for Buffalo's Milk or 'Whole' Milk*

<i>Age</i>	<i>Milk Proportion</i>	<i>Water Proportion</i>
Birth to one month	1	I
One to four months	2	I
Four to six months	3	I
Beyond six months	Undiluted	—

other artificial milks. The mothers from lower and middle socio-economic groups who constitute the country's major population cannot carry out the instructions mentioned on the milk tin as those are in a language which is foreign to them and which are understood by only a small percentage of the villagers that is literate. Many of the educated parents cannot interpret what is meant by an ounce, so that they cannot be expected to prepare a formula on the basis of one measure to one ounce. There are a number of instances where graduates, postgraduates of arts and science and at times even doctors could not indicate correctly the capacity of a cup, a glass or



other domestic utensils which mothers commonly use for taking water to prepare the formula. Mothers add one or two measures of powder to a cupful or a glassful of water and thus serve that four to eight times diluted milk to the infant. Very few mothers use one ounce graduated feeding bottles. When humanised milk powder is prescribed, thorough care should be taken to advise on the preparation of formulae and hygiene of the bottle and teat.

### *Bottles and Teats*

It has been reported that deaths among bottle-fed babies were four times as many as among breast-fed babies. The contribution made by feeding bottles and teats in the genesis of marasmus is underestimated. The proper type of bottle which can easily be cleaned and sterilised is a vertical bottle, a type of Morrison's. The community, where one faces the problem of malnutrition, is habituated to utilise 'medicine' bottles or 'Gripe Water' bottles for feeding as these do not cost an additional amount and are available at home.

Ideally and theoretically, the bottle should be cleaned after every feed, brushed and then washed with running water and sterilised in boiling water. Similarly, the teats should be cleaned with a pinch of salt, washed and boiled for a minute or two. This is surprisingly advised by many doctors. Logically it sounds impractical as the mother has to contribute much of her time, kerosene, gas or wood-fuel every three or four hours for preparing feeds for one of her children, which in practice she cannot afford as either she is working out in the fields or she is pressed for time with heavy family chores in an extended family system. Thus, in practice, probably she boils the bottle once a day. Moreover, sterilising the bottle does not solve all the problems as the sterilised bottle and teat are later on kept generally exposed to a number of environmental factors which lead to contamination. Many a time, out of her general habit, the mother touches the teat with her fingers or "cleans" it with her (contaminated) sari. In a developing country, bottle feeding is thus to be viewed from a different angle. There is no wonder that some paediatricians in developing countries have advised their Governments not to import nor to permit

the manufacture of humanised milk powders as it leads to a number of complications like recurrent gastro-enteritis and marasmus. One paediatrician, in a manual written for his students, has included a diagram of a feeding bottle with a caution "Don't give this bottle to a child. It will kill him". This may seem an extreme step, but considering the realistic situations in poor socio-economic communities this might be a reasonable precaution.

The teats have their own problems like size of hole, type of rubber used and the associated smell. The child has to struggle hard for getting milk through a small hole and gets exhausted, sleeps and wakes up hungry after a short time, and cries. This easily leads to a change in the formula, a further dilution by the mother or grandmother who interprets child's crying to its inability to digest that formula and the resultant abdominal pain. A good hole in a teat is one which permits the milk to flow drop by drop when the bottle is inverted. On account of the type of rubber used, some of these teats regain their former very small holes even when the holes are made bigger with a hot needle. Considering the complications associated with bottles and teats it is imperative to advise the mother on proper preparation of formula and dilution of milk, proper sterilisation and to see that a fairly satisfactory flow of milk is maintained.

In situations where a child is to be kept on bottle feeding, we should advise on washing and cleaning of the bottle with a brush in the mornings and boiling it in water. This bottle should be taken out of the pan with clean and washed hands and boiled water preserved. After each feeding during the day, the bottle should be cleaned with running water and be kept in the boiled water which was prepared in the morning as indicated already. The hands should be washed every time before handling the bottle and the teat. This suggestion is not an ideal one but is a compromise when there is a shortage of water, time and money.

While feeding, the bottle should be taken out of the babies' mouth frequently for maintaining the air pressure inside. Bottle feeding as such should not be continued beyond two



years of age; otherwise the child will develop psychological attachment to the bottle. It is worthwhile to advise on replacing the bottle by a spoon and cup or some domestic utensils as with these the problems of contamination are probably fewer.

## WEANING

In preventing malnutrition, weaning is as important as breast feeding. Weaning should be started at the right time to provide adequate calories and proteins for the normal growth of a child and to enforce timely food habits. In old days, when the population in India was limited and per capita consumption of milk was much more by the children, the introduction of semi-solids and solids was delayed upto one year. At present, the availability of milk per family is only 4 to 5 ounces per head per day and out of this a good amount is diverted for tea, sweetmeats and other milk products which are relished by adults, and a poor infant has to rely for his additional calories and proteins on some other sources. Although mother's milk is adequate in protein and calories, with an average production of 600—700 ml. per day, upto five to six months of lactation, for older babies additional artificial milk or semi-solids and solids have to be introduced so as to cover the deficit of calories and proteins from five months onwards. The death rate after six months has been predominantly high among infants not receiving such solids. Cow's or buffalo's milk is an expensive item for the majority in the community, thus it is worthwhile to identify some cheap sources of calories and proteins from cereals and pulses at the time mentioned in Table V. The food habits, like vegetarianism and non-vegetarianism, have to be taken into account. At the same time, common food articles which the families are already used to, would be easily accepted for weaning without much social resistance. The choice of weaning foods will be from those food items which are cooked or boiled and have minimal chances of contamination. The preparations mentioned in the table should be introduced gradually and then continued to be given in increasing amount. These should be non-irritating, soft and palatable and even if they cannot be cooked separately, should be carefully taken out from the family's



TABLE V

*Time Table for Introduction of Semi-Solids and Solids*

<i>Age in months</i>	<i>For Vegetarian families</i>	<i>Additional items for Non-Vegetarians</i>
Second and Third	Dal Water (Supernatant Dal Water) (4-8 Teaspoons) Vegetable soup (4-8 Teaspoons)	Meat soup (4-8 Teaspoons)
Fourth and Fifth	Above items in increased quantity "Pej", "Kanji" Sago from cereals (8-12 Teaspoons) Mashed vegetables (30-40 Gm) Mashed banana (half) Papaya, Potato (30-40 Gms) Thick dal, "Sambar" (8-12 Teaspoons)	Above item in increased quantity. Yolk of one egg. Bone marrow Minced meat (30-40 Gms) Mashed fish (30-40 Gms)
Sixth and Seventh	Above items in increased quantity and soft rice, rice with dal (2-8 Ozs.) Khichadi, Idli, soft bread, biscuit	Above items in increased quantity. Whole egg
Eighth and Ninth	Above items in increased quantity and softened roti with milk or Jaggery. Thick gram curry ("Pithala") with rice	Items as above

food before the addition of spicy condiments. It is very essential that these foods should be cheap. Many more items could be added to the list, depending on the food habits of the family. Commercially processed weaning foods are expensive and if purchased on account of advertisement, the mother uses it in a very small quantity which limits the presumed quality of the product.

TABLE VI

*Proteins and Calories from various Food items worth Rupee 0.30*  
*(Rates as prevalent in Palghar during May, 1972)*

<i>Foods Items</i>	<i>Calories</i>	<i>Proteins (Gms)</i>	<i>Chemicals Score of Proteins (N.P.U.)</i>	<i>Food Items</i>	<i>Calories</i>	<i>Proteins (Gms)</i>	<i>Chemical Score of Proteins (N.P.U.)</i>
<b>PULSES</b>							
Egg	104	8	100	Bengal grams (Chana)	864	41	44
Meat	960	9	90	Bengal grams (dal)	688	37	44
Fish				Green grams (Mung)	501	36	44
Mackerel	140	28.6	83	Lentil (Masur)	456	33	44
Pomfret	68	12.6	75				
Mandli	220	44					
Prawn	54	11					
Milk	210	7					
<b>CEREALS</b>							
Wheat	943	35	52	Black grams (Urd)	359	28	44
Rice	593	15	57	Mothbeans (Matki)	792	51	44
Bajra	1083	35	56	Rawari (Chawli)	646	48	
Jowar	1163	35					

Peas dry (Matur sukhi)	674	43	44	LEAFY		
Red grams (Tur dal)	402	27	44	VEGETABLES		
Bengal grams roasted dehusked	369	22	56	Fengram (Methi) Spinach (Palak)	75 39	6 3
(Bhuna chana)						
Soya beans	309	31		COMMERCIAL		
Beans (Val)	740	44		PRODUCTS		
OIL SEEDS				Artificial	100	5
Ground nuts	680	30		milk Powder		75
Ground nut roasted	425	19	48	Protein Powders		
Sesame (Til)	510	39	56	Uniprotein	26	4
Cashewnuts	198	7		Proteinules	21	3
(Kaju)				Protein Biscuits		
Almond	30	1		Uni-Briskies	75	3
(Badam)						60



*Cheap Sources of Proteins and Calories*

In many of the developing countries, a major cause of malnutrition is poverty. Malnutrition could be prevented with adequate calories and proteins in diet. The proteins from animal sources are superior due to their biological values as they have high Net Protein Utilisation (N.P.U.) value. Unfortunately, those are very expensive items of foods. In practice, to prevent or to manage malnutrition, it is essential that the cheaper sources of proteins and calories are given full consideration. Calories and proteins derived from various food items when purchased for a price equivalent to that of an egg, are mentioned in Table VI. This is an important table which shows a great quantitative difference between the proteins from animal and vegetable origin when purchased for a given amount of money. Pulses purchased with the money needed to buy an egg give three to six times more proteins than an egg and three to eight times more calories; groundnuts give four times and seven times more of proteins and calories, respectively. Giving due considerations to the type of the essential amino acids of higher biological value in an egg, the difference is still outstanding in favour of pulses and groundnuts. It is recognised that proteins of vegetable origin have lower N.P.U. value due to lack of one or two essential amino acids. However, if these are consumed one and half times or twice as much, they can meet the daily need. Table VII mentions the daily need of proteins from vegetable sources. A rupee spent on cereals except rice, gives four times as much proteins and nine to twelve times as many calories as a rupee spent on eggs. When pulses and cereals are eaten at the same time, the biological value of the proteins of these foods increases as the combination increases the quantity and raises the quality and fills up the deficiency gap of essential amino acids. Leafy vegetables also have proteins and when taken along with pulses or cereals their N.P.U. increases.

Hence, a combination of cereals and pulses or leafy vegetables is an economical way of preventing malnutrition. Cereals are deficient in lysine, and both pulses and cereals have low levels of methionine. Sesame is a good source of methionine.

TABLE VII

*Daily Requirements of Calories and Proteins  
during Infancy and Childhood*

Age and Sex		Calories	Vegetable Proteins in Gms. (Corrected against the reference proteins after six months)
0 — 3 months	Boys Girls	120 per kg.	8 — 13
4 — 6 months	„ „	„	11 — 14
7 — 9 months	„ „	„	13
10 — 12 months	„ „	„	13
1 — 3 years	„ „	1200	19 — 21
4 — 6 years	„ „	1500	28 — 36
7 — 9 years	„ „	1800	39 — 48
10 — 12 years		2100	49 — 57
13 — 15 years	Boys	2500	59 — 78
13 — 15 years	Girls	2000	61 — 71
16 — 18 years	Boys	3000	77 — 82
16 — 18 years	Girls	2200	69 — 70

(50th percentile of the Harvard reference standard weight is taken into account for each age group).

This basic information could be utilised while planning the menu.

When poverty is the dominating factor in the genesis of malnutrition, and many a time it is, the problem of malnutrition has to be tackled with cheaper sources of calories and proteins. Often increase in quantity is more important than the change in quality of children's diet. It is unwise to advise these parents to give milk, egg and expensive protein powders.

At times, the parents make a request for "tonics" and the medical personnel are tempted to prescribe protein powders or protein biscuits and the mother is not told about the need to modify diet. Parents expect a magic action with these "tonics" and protein powders in a dose of few teaspoons which will give a very limited amount of proteins considering the requirement of a child. The parents soon realise that after giving one or two tins of these tonics their child does not improve. They lose faith in the doctor and the medicine. Hence, it is imperative to give full thought to the essential tool in the prevention of malnutrition, and that tool is health education. The parents should be advised to select the kind of food for their children which could be bought cheap and which could provide adequate calories and proteins, even though they may be from vegetable sources. For a non-vegetarian, small fish or variety of fish like "Mandli" in Maharashtra are cheap sources of animal proteins.

#### *Consideration to Habits and Availability of Foods*

Another vital point in preventing malnutrition is an advice regarding diet which can be socially acceptable to the family, and which can be prepared from the locally available food items. Food habits, beliefs and attitudes are deep-rooted and are difficult to change. The Indian diet generally consists of cereals and pulses, and hence it is possible to provide fairly adequate amount of calories and proteins from the traditional family diet. Introducing new items into the diet which have to be brought from outside their region will often lead to a number of problems. The protein powders or some other high protein foods processed in a factory in bulk have to be transported to the remotest villages and hamlets, which is an extremely difficult task. Moreover, as the parents are not used to utilising that as a food, and as they do not know the sources of that nutritious food in powder forms, they take it as a medicine in very small quantities and not as a food. This lowers the utility of the protein powders, biscuits and other foods.



### *Special Preparation of Foods for Infants and pre-School Children*

Semi-solids and solids served to the infants and pre-school children should be in a soft, chewable and palatable form with very little or no spicy condiments added. The mother is to be convinced that she has to spare a little more time to prepare an item for children separately from those prepared for adults. Usually, infants and pre-school children are fed the same diet which the adults in the family eat. Some of the foods from pulses, cereals or groundnuts can be prepared in small quantities for weekly or fortnightly requirements. This procedure will also economise on time and money. These could be served by an elder sister or brother even during the absence of parents when they go out for work.

### *Food Beliefs and Attitudes*

There are deep-rooted beliefs and attitudes towards various foods all over India in all regions and in all castes. This makes it imperative to know the local food beliefs and attitudes. Many foods are considered as "hot" or "cold" and "heavy" or "light". It is surprising to know that a village has altogether different food customs from a neighbouring one. In one small community in Maharashtra, 'khichadi' a preparation of rice and pulse, is served only when the members of their family return from a funeral, and hence in that community it is wise to talk about other foods for the child rather than about 'khichadi'.

Due consideration should be given to the food beliefs of the family and a balanced menu, neutralising excessive "hot" and "cold" or "heavy" and "light" foods. Some of the food habits are not harmful. The grandmothers have a special say in the feeding of infants and pre-school children and it is she who is to be approached for modifying children's diet. As mentioned above, nowhere in India is it difficult to recommend an appropriate preparation since there is such a variety in Indian dishes. This is true of even the poorest family. Preventing malnutrition in economically well-to-do families is not a difficult task. However, the economically well-placed families

have 'prestige' or 'status' foods. They will prefer a vegetable preparation out of lady's fingers to that out of spinach. Excessive serving of 'ghee' is an attempt to project a family's superior financial position. These habits may wrongly influence the poor communities as the latter may think that the health of a baby from a rich family is due only to biscuits, milk powders, 'tonics' and status foods, and they would unconsciously attempt to follow rich families' examples.

## EARNING MOTHERS

In India, more than 60 per cent of mothers from poor economic conditions are daily-wage earners and the feeding of their infants and pre-school children is left to a grandmother or elder sister or brother. These infants get breast feeds in evenings and nights. However, they are exposed to all the hazards of bottle feeding by the persons who have the least amount of experience in the complexity of the preparation of a formula.

It is from this formidable segment of the population that the maximum number of cases of severe malnutrition arise. The problem will multiply with increasing urbanisation. Malnutrition in these children could be combated if the person who manages the child in the mother's absence is given proper nutrition education. Nutrition Day Care nurseries where these infants and children are looked after and given nutritional supplements during the mother's absence may help to minimise the problems.

## NUTRITION AND INFECTIOUS DISEASES

Episodes of infectious diseases play a role in the genesis of malnutrition. During severe infections the tissues are broken down and there is an associated increased metabolism demanding additional need of proteins. Many of the infections are associated with anorexia. Restricted diet is very often given to an ill child on account of the belief in infectious diseases which leads to negative nitrogen balance with increased need



and poor intake. And hence, if the illness continues for some time, a child who is already moderately malnourished progresses to severe malnutrition.

Severe infections, particularly measles and whooping cough are notorious for precipitating severe malnutrition as there is diminished intake of food and excessive loss of body proteins. Many of the infectious diseases are preventable by immunisation. Timely immunisations as mentioned in Table VIII are one of the important measures for preventing malnutrition. The immunisation schedule mentioned here is recommended by the WHO for India. After due consideration of the recent observations, the dose schedule of poliomyelitis has been altered and is different from what was suggested by the WHO. D.P.T., when in the alum-adsorbed form is to be given in only two doses at an eight-weekly interval. The latter schedule is more a practical suggestion than an ideal for the community health programmes. If not immunised in the past and seen for the first time during late infancy or pre-school period, all the immunisations could be given at one time.

## DIET DURING ILLNESS

Due to traditional beliefs, children in India are given less food during illnesses when their requirements are in fact more. Except in the severe toxic state of the child or in paralytic ileus, persistent vomiting or when it is advised by a doctor that nothing be taken by mouth, the feeding of children should continue even during illnesses. Even in acute gastro-enteritis, the starvation period should be shortened to few hours and be restricted only to paralytic ileus, persistent vomiting or very toxic condition of the child. The recent trend in managing a child with gastro-enteritis is to feed him at the earliest with the formula he was used to before his illness. A child suffering from enteric fever be given non-irritant, low residual food in adequate quantity.

Children should not be starved or semi-starved during illnesses unless indicated due to associated severe complications. This procedure of feeding ill children will help in the prevention of deterioration in the nutritional status of the children.

NU110

03078

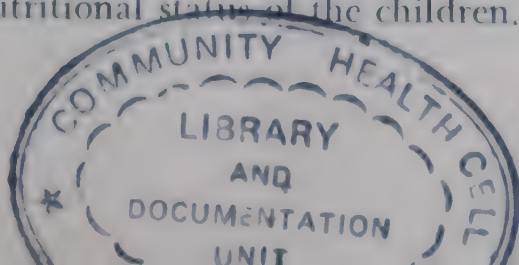




TABLE VIII

*Time-table for Immunisations*

<i>Age</i>	<i>Vaccine</i>	<i>Comments</i>
1st Week	B.C.G., & Smallpox vaccinations	1) If child comes for the first time late during infancy or afterwards, same time-intervals between various doses to be followed. But he could be given all the immunisations except T.A.B., at a time on a single visit.
4 months	D.P.T. I dose; Polio I dose	
6 months	D.P.T. II dose; Polio II dose	
8 months	Polio III dose (During high risk season or otherwise, if Polio I dose given at 3 months, other two doses will follow at 5 & 7 months)	2) If he has received only one dose in the past and then there is a long interval, (more than six months) a fresh full course of two D.P.T. and three Polio doses to be given.
20 months	Booster Polio	3) If he has received two doses of Polio and interval is long (more than six months) after the last dose, a course of two more Polio doses at two-monthly interval be given.
2 years	Booster D.P.T.	
3 years	T.A.B.—two doses at week's interval. Smallpox re-vaccination	4) Except for very acute illnesses, and low birth weight of less than 1.5 kg., there are no specific contra-indications for immunisations. However, when the baby has diarrhoea, oral Polio should be postponed for a later period.
5 years	Boosters: D.P.T., B.C.G., Polio	
6 years	Smallpox re-vaccination	5) The immunisation against poliomyelitis in villages be given whenever indicated.
10 years	Diphtheria and Tetanus toxoid  Repeat Smallpox vaccination every 3 years and T.A.B. every year	

## DIARRHOEA AND MALNUTRITION

Out of the commonest infections during infancy and early childhood period diarrhoea stands second only to upper respiratory infection. Repeated attacks of diarrhoea where there is associated protein loss and diminished intake of food lead to severe malnutrition. The root cause of diarrhoea is insanitary conditions associated with shortage of water supply, plenty of flies and undisposed excreta. Bottle, teat and diluted milk formulae contribute to repeated attacks of diarrhoea. Some of the cases of recurrent diarrhoea have giardiasis, ascariasis or other parasitic infestations. It is revealed from various studies that 40 to 60 per cent of acute diarrhoea are due to pathogenic organisms. It is also observed that morbidity attacks with diarrhoea are more in children whose nutrition is poor. Hence, diarrhoea and nutrition are closely inter-related.

The cases of diarrhoea should be promptly treated with oral fluids containing salt and sugar. Two teaspoons of sugar and one-fourth teaspoon of salt in a glassful of water should be given. This formula is similar to the half strength glucose-saline solution. Appropriate drugs for infection or infestation should also be given. A very important aspect in the treatment of recurrent diarrhoea is to prevent the attacks of diarrhoea. This can be done through proper health education in simple language, and by demonstrating the preparation of appropriate food under hygienic conditions. The prevention of diarrhoeal attacks is essential, though difficult, during the first year of life. That is easier if the baby is breast fed. Later on, children develop some amount of resistance or immunity. The proper disposal of excreta, the reduction of the breeding grounds of flies, and provision of adequate disinfected water are the necessary measures that must be taken into consideration to reduce the diarrhoeal attacks.

## INFESTATION AND PREVENTION OF MALNUTRITION

A roundworm eats away about 0.1 gm. of protein per day from human intestine. Hence, one can well imagine the fate

of a child having multiple roundworms. Whipworms are notorious for chronicity and lead to chronic diarrhoea and at times bleeding per rectum. These infestations should be prevented and treated in time, and reinfection prevented. In a community, if about half the number of pre-school children have heavy parasitic infestation, it is worthwhile to take up periodic deworming with broad-spectrum anti-helminthic drugs. Periodic deworming every three months with some change in sanitary and hygienic conditions can bring down the incidence of worm infestation to a negligible level within a few years in a given community. It may not be possible to examine stools of all the children. But considering the high incidence of ascariasis and, at places, of hookworm, every pre-school child may be considered for a three-monthly deworming schedule in highly infested regions. These children and the parents should also be told about the importance of washing hands every time before eating. Cutting of nails and other hygienic procedures are also to be equally emphasized.

## PLANNING OF FAMILIES AND NUTRITION OF CHILDREN

It is recognised that the incidence of malnutrition increases in children whose birth order is fourth and beyond. Their protein calorie intake comes down and these children have higher morbidity attacks and relatively poor physical growth. Hence, properly planned families will help in preventing malnutrition. Spacing two children by three to four years should be more emphasized rather than merely reducing the size of families by sterilisations. Good nutrition of children will make the parents come forward for planning of the families as they themselves know that a small family is a healthy and happy family. Motivation for family planning can be imbibed better by a medical worker who looks after the children and has interest in their well-being rather than by someone who has only a transient contact with the family and looks at personal benefit. The proper dialogue for spacing the interval between two childbirths or for sterilisation should be initiated when couples are in a receptive frame of mind. That may



be when the child is well-nourished and protected against infectious diseases through immunisation which may be a few months after the birth. Better nutrition and better child care become easy for the average family if it is well-planned.

### PREVENTION OF FOETAL MALNUTRITION

In all the developing countries, low birth-weight is a great neonatal problem. One of the commonest causes of neonatal and infant mortality in India is low birth-weight and/or prematurity. The babies who have low birth-weights background many a time continue to be under-weight for years and end up in moderate to severe malnutrition. They are prone to infections. Thus, a reduction in the incidence of foetal malnutrition will prevent malnutrition during infancy and early childhood period.

The problem of foetal malnutrition can be approached through proper care of the mothers during antenatal period, and by introducing a system of detecting and registering "At Risk" mothers who may otherwise deliver low-birth-weight babies. Primipara, women who have had multiple pregnancies, a low-weight mother weighing less than 38 Kgs. before pregnancy or 40 Kgs. at 20th week of pregnancy and shorter mothers with a height of 140 cms. or less are the mothers who require special care and nutrition supplements during last six to eight weeks of pregnancy to reduce the incidence of foetal malnutrition.

### PREVENTING MALNUTRITION IN SCHOOL CHILDREN

Half the number of school children are malnourished. Many of them have had malnutrition from their infancy and pre-school age.

Prevention of malnutrition in school children is possible by giving advice on proper diet and by introducing supplementary meals in the schools. Care should be taken to see that meals in schools do not replace meals at home. Associated parasitic infestations may be tackled by periodic deworming, if incidence of worms is high in the region. School children

can be approached with ease and hence the problem of malnutrition in that age group can be tackled more efficiently than in pre-school children through nutrition education and demonstrations so that they also alter their diet in quality and quantity at home. Health and nutrition education should be introduced in the school curriculum. Involvement of these children in development of school gardens and simultaneous kitchen gardens at home is a better method of nutrition education.

## COMPREHENSIVE PROGRAMME FOR PREVENTION OF MALNUTRITION IN THE COMMUNITY

### *Integrated Under-Fives Clinics*

The problem of malnutrition, whether prevention or management, is to be solved more at the community level rather than in the hospitals. This can be done if the health services are provided to the community on lines different from those followed at present. Nutrition, health, growth and development, immunisation and deworming along with family planning, educational activities for infants and pre-school children and domiciliary activities by medical and paramedical personnel can be integrated through 'Under-Fives' Clinics'. These clinics are meant for children under five years of age and can be combined with antenatal and postnatal clinics. The children are followed up at monthly intervals during the first year, two-monthly intervals during the second year and three-monthly thereafter. To prevent malnutrition the types of children mentioned below require greater attention and special care as their needs are greater.

1. Twins
2. Pre term or Low-birth-weight babies weighing less than 1.5 kg
3. Those who have difficulties in breast feeding and put on bottle feeding before six months of life
4. Those who have only one of the parents
5. Those whose mothers are working, and are fed by elder sisters/brothers or grandmothers.

6. Those who fail to gain weight of 0.5 kg. a month in the first trimester or 0.25 kg. a month during the second trimester of life
7. Where there is a history of deaths of more than two siblings between the ages of one to twelve months
8. Those who had severe or repeated diarrhoea in the early months of life or a recent attack of measles or whooping cough
9. Those whose birth order is fifth or beyond, and
10. Those whose weight is below 60 per cent of the reference standard.

The children are weighed and given immunisations at the clinic. Each mother is being explained to the meaning of the directions of the weight curve on the weight chart and how to co-ordinate the child's health with the weight curve. A flattened curve is an indication for a discussion of the child's diet with mother and an upward trend in the weight thereafter suggests that the discussion in modifying and improving the frequency and content of the meals has been successful. The nutrition and health education is given at the clinics to a small group of mothers and once in a month nutrition demonstrations are arranged to show the preparations from cheap foods which give fairly adequate calories and proteins. These children are followed up at homes by the nursing auxiliaries at regular intervals so that each child is seen at least once in a month. At home, nursing personnel have to weigh the "Special care" child at frequent intervals and others who could not report at the clinic (Pl. 1) and they check up the diet given to the child and advise accordingly.

### *Domiciliary Out-reach*

It has been the experience at a number of centres that the follow-up attendance is not satisfactory as the mothers do not bring their children to "Under-Fives' Clinics" regularly. This is due to the fact that more than sixty per cent of the mothers from poor socio-economic group go for work on daily wages and



they cannot afford to lose their income, which may be forty per cent of the family's gross income of that day, for a follow-up of their apparently healthy children. Other mothers who remain at home do not like to disturb their family routine of looking after other children and day-to-day chores of cooking, fetching water and many other activities. They are deeply interested in the health and well-being of their children but cannot afford to go to health centre a number of times for their own, their infants' and pre-school children's check-ups each on different days and at different hours. Hence, it is imperative that the clinics look after the under-five-year children and also the antenatal and postnatal mothers at the same time and on the same day, so that during one visit a mother can get her infant weighed and immunised, pre-school children checked up and get herself also examined. This can be done if the clinic timings are fixed according to the convenience of the mothers for whom the establishment is meant. In a village or city the clinic timings should be fixed in the afternoons or evenings, when mothers return from their jobs or are free from family chores. This should be on a particular day of the week for a specified area. This sort of change in timings and day will lead to better clinic attendance, follow-ups and better utilisation of health services. However, there will still be some mothers who cannot even attend these clinics because of jobs or home responsibilities. Their children should be followed-up by home visits. The weight of these children can be taken on a weighing scale which is handy. The auxiliary nurse-midwife can go to the homes, weigh children and enter the weight in charts and tell the mother about the weight curve and progress of the child. She can even immunise these children at homes (Chart I).

Such comprehensive "Under-Fives' Care" and maternal health care programme can be introduced at all the primary health centres and their sub-centres. The children should be grouped according to their percentage of expected weight of the reference standard (Table III) and should be given special care if moderately or severely malnourished. The grade of malnutrition can be assessed by slipping the weight chart in specially devised plastic folder overlay (Pl. 7). There are weight



## CHART I



curves on the overlay which indicate the grade of malnutrition and the health worker can assess the state of nutrition of a child within a fraction of a moment. Parents may be advised to modify the diets of the children and increase the frequency of feeding. Those who are extremely poor can be given nutrition supplements from the local sources. Finance for this may be sought from the local community, Panchayats, Zilla Parishads or Municipalities. This is possible if the local community is convinced about the benefits out of those clinics. Mid-day meal programme may be extended to the school children who are extremely poor and whose parents cannot modify their family's diet. The Applied Nutrition Programme can contribute to these nutrition programmes.

Similar types of activities can be organised at clinics in cities where mothers and children could be followed up at the same time, on a fixed day according to areas. A general practitioner can establish "Under-Fives' Clinics" and maternal health programmes where he can involve paramedical personnel or social workers.

Through such clinics and types of services the problems of malnutrition can be managed fairly well and prevented to a great extent.

#### COLLABORATION WITH VARIOUS DEPARTMENTS AND COMMUNITY PARTICIPATION

The proposed type of health and nutrition programme will increase the workload of the nursing auxiliaries and doctors who are already burdened with heavy work. This can be brought down by involving part-time workers, or school teachers or volunteers from youths' and women's clubs in the communities. Co-ordinated efforts along with the staff members of other departments like Social Welfare, Agriculture, Animal Husbandry, Education, Rural Development, and with local leaders will help in better organisation of these programmes and ultimately bring down the incidence of malnutrition. Built-in participation of the local people preferably even at the level of the smallest community groups is of utmost importance for long-term continuation of the programmes.







## EVALUATION OF PROGRAMMES

The programmes mentioned above should be evaluated from time to time through (i) periodic QUAC-stick survey; (ii) charting the weight dots of a number of children from a given community on a weight chart and comparing the weight dots at monthly intervals; and (iii) monthly Built-in-Evaluation (Table IX). The latter method not only depicts the state of nutrition of all the children under five years in the community but also indicates the improvement or otherwise in their status. It involves the use of weight charts and plastic folder stencil.

## A P P E N D I C E S



APPENDIX I  
Length/Height (in cms.) of children under six years

Age in months	Harvard Standard	Percentage of the Reference									
		95	90	85	80	75	70	65	60	55	50
3	60.0	57.0	54.0	51.0	48.0	45.0	42.0	39.0	36.0	33.0	30.0
6	65.8	62.5	59.2	55.9	52.6	49.4	46.1	42.8	39.5	36.8	32.9
9	70.7	67.6	63.6	60.0	56.5	53.0	49.5	45.9	42.4	38.8	35.3
12	74.7	71.0	67.2	63.3	59.8	56.0	52.3	48.5	44.8	41.1	39.0
15	78.1	74.2	70.3	66.4	62.4	58.6	54.6	50.8	46.8	42.9	39.3
18	81.4	77.3	73.2	69.2	65.1	61.0	57.0	52.9	48.8	44.8	40.7
21	84.4	80.2	76.0	71.7	67.4	63.3	59.0	54.9	50.7	46.4	42.2
24	87.1	82.7	78.4	74.0	69.6	65.3	60.9	56.6	52.2	47.9	43.5
29	89.7	85.2	80.7	76.4	71.5	67.3	62.7	58.3	53.8	49.3	44.8
30	91.8	87.2	82.6	78.0	73.4	68.0	64.2	59.7	55.1	50.5	45.9
33	94.0	89.3	84.4	79.9	75.1	70.5	65.7	61.1	56.3	51.7	47.0
36	96.0	91.0	86.4	81.6	76.8	72.0	67.2	63.4	57.6	52.8	48.0
39	97.9	93.0	88.0	81.2	78.4	73.4	68.6	63.6	58.7	53.8	49.0
42	99.7	94.7	89.7	84.7	79.7	74.8	69.5	64.8	59.5	54.9	49.8
45	101.6	96.5	91.5	86.4	81.3	76.2	71.1	66.0	60.9	55.9	50.8
48	103.3	98.1	93.0	87.8	82.6	77.4	72.3	67.1	62.0	56.8	51.6
51	105.2	99.9	94.5	89.4	84.0	78.9	73.4	68.4	63.1	57.9	52.6
54	106.8	101.5	96.1	90.8	85.4	80.1	74.7	69.4	64.1	58.7	53.4
57	108.2	102.8	97.2	92.0	86.3	81.1	75.7	70.3	64.9	59.9	54.1
60	109.0	103.5	98.0	92.6	87.1	81.7	76.2	70.8	65.3	59.9	54.5
Boys 66	114.4	108.7	103.0	97.2	91.5	85.8	80.1	74.4	68.0	62.9	57.2
72	117.5	111.6	105.7	99.8	94.0	88.1	82.2	76.4	70.0	64.6	58.7
Girls 66	112.8	107.2	101.5	95.9	90.2	84.6	79.0	73.3	67.7	62.0	56.4
72	115.9	110.1	104.3	98.5	92.7	86.9	81.1	75.3	69.5	63.7	57.9

## APPENDIX II

*Chest Circumference (in cms.) of children under six years*

Age in months	Harvard Standards	Percentage of the reference									
		95	90	85	80	75	70	65	60	55	50
3	40.6	38.5	36.5	34.5	32.5	30.5	28.4	26.4	24.4	22.3	20.3
6	43.7	41.5	39.2	37.0	34.9	32.7	30.6	28.4	26.2	24.0	21.9
9	46.0	43.7	41.4	39.1	36.8	34.5	32.2	29.9	27.6	25.3	23.0
12	47.3	44.9	42.6	40.2	37.8	35.5	33.1	30.7	28.4	26.0	23.6
15	48.3	45.9	43.5	41.0	38.6	36.2	33.8	31.4	29.0	26.5	24.1
18	49.2	46.7	44.3	41.8	39.4	36.9	34.4	32.0	29.5	27.1	24.6
24	50.4	47.9	45.4	42.8	40.3	37.6	35.3	32.8	30.2	27.7	25.2
30	51.5	48.9	46.3	43.8	41.2	38.6	36.1	33.5	30.9	28.3	25.7
36	52.2	49.6	47.0	44.4	41.8	39.2	36.6	34.0	31.3	28.7	26.1
42	52.3	50.2	47.5	44.9	42.2	39.6	37.0	34.3	31.7	29.0	26.4
48	53.4	50.7	48.1	45.4	42.7	40.0	37.4	34.7	32.0	29.4	26.7
54	54.0	51.3	48.6	45.9	43.2	40.5	37.8	35.1	32.4	29.7	27.0
60	54.6	51.9	49.1	46.4	43.7	41.0	38.2	35.5	32.8	30.0	27.3
<i>Boys</i>											
66	55.3	52.5	49.8	47.0	44.2	41.5	38.7	35.9	33.2	30.4	27.6
72	56.1	53.3	50.5	47.7	44.9	42.1	39.3	36.5	33.7	30.8	28.0
<i>Girls</i>											
66	53.7	51.0	48.3	45.6	43.0	40.3	37.6	34.9	32.2	29.5	26.8
72	54.5	51.8	49.0	46.3	43.6	40.9	38.1	35.4	32.7	29.9	27.2

## APPENDIX III

*Head Circumference (in cms.) of children under six years*

Age in Harvard Months Standard		Percentage of the Reference Standard									
		95	90	85	80	75	70	65	60	55	50
Boys											
3	40.9	38.8	36.8	34.7	32.7	30.6	28.6	26.5	24.5	22.4	20.4
6	43.9	41.7	39.5	37.3	35.1	32.9	30.7	28.5	26.3	24.1	21.9
9	46.0	43.7	41.4	39.1	36.8	34.5	32.2	29.9	27.6	25.3	23.0
12	47.3	44.9	42.6	40.2	37.8	35.5	33.1	30.7	28.4	26.0	23.6
15	48.0	45.6	43.2	40.8	38.4	36.0	33.6	31.2	28.8	26.4	24.0
18	48.7	46.3	43.8	41.4	39.0	36.5	34.1	31.6	29.2	26.8	24.3
21	49.7	47.2	44.7	42.2	39.8	37.3	34.8	32.3	29.8	27.3	24.8
30	50.2	47.7	45.2	42.7	40.2	37.6	35.1	32.6	30.1	27.6	25.1
36	50.4	47.9	45.4	42.9	40.0	37.8	35.3	32.8	30.2	27.7	25.2
48	51.1	48.5	46.0	43.4	40.9	38.3	35.8	33.2	30.7	28.1	25.5
60	51.2	48.6	46.1	43.5	41.0	38.4	35.9	33.3	30.8	28.2	25.6
66 & 72	51.3	48.7	46.2	43.6	41.1	38.5	36.0	33.4	31.5	28.3	25.6



## Girls

3	40.0	38.0	36.0	34.0	32.0	30.0	28.0	26.0	24.0	22.0	20.0
6	42.8	40.7	38.5	36.4	34.2	32.1	29.9	27.8	25.7	23.6	21.4
9	44.6	42.3	40.1	37.9	35.7	33.5	31.2	29.0	26.8	24.5	22.3
12	45.8	43.5	41.2	38.9	36.6	34.3	32.1	29.8	27.5	25.2	22.9
15	46.5	44.2	41.8	39.5	37.2	34.9	32.5	30.2	27.9	25.6	23.2
18	47.1	44.7	42.4	40.0	37.7	35.3	33.0	30.6	28.3	25.9	23.5
24	48.1	45.7	43.3	40.9	38.5	36.1	33.7	31.3	28.9	26.4	24.0
30	48.8	46.4	43.9	41.5	39.0	36.6	34.2	31.7	29.3	26.8	24.4
36	49.3	46.8	44.4	41.9	39.4	37.0	34.5	32.0	29.6	27.1	24.6
48	49.9	47.4	44.9	42.4	39.9	37.4	34.9	32.5	30.4	27.4	24.9
60, 66 & 72	50.4	47.9	45.4	42.9	40.4	37.8	35.3	32.8	30.7	27.7	25.2

## APPENDIX IV

*Arm Circumference (in cms.) of children under six years*

Age in Months	Wolanski Standard	Percentage of the Reference									
		95	90	85	80	75	70	65	60	55	50
Boys											
3	12.7	12.1	11.4	10.8	10.2	10.6	8.9	8.2	7.6	7.0	6.4
6	14.5	13.8	13.1	12.4	11.6	10.9	10.2	9.4	8.7	8.0	7.3
9	15.8	15.0	14.2	13.4	12.6	11.8	11.0	10.2	9.5	8.7	7.9
12	16.0	15.2	14.4	13.6	12.8	12.0	11.2	10.4	9.6	8.8	8.0
15	16.1	15.3	14.5	13.7	12.9	12.1	11.3	10.5	9.7	8.8	8.0
18	15.7	14.9	14.1	13.3	12.5	11.9	11.0	10.3	9.4	8.6	7.8
21	16.2	15.4	14.6	13.7	13.0	12.1	11.4	10.5	9.7	8.9	8.1
24	16.3	15.5	14.7	13.8	13.0	12.2	11.4	10.6	9.8	8.9	8.1
30	16.4	15.6	14.8	13.9	13.1	12.3	11.5	10.7	9.9	9.0	8.2
36	16.2	15.4	14.6	13.7	13.0	12.1	11.3	10.5	9.7	8.9	8.1
42	16.5	15.7	15.0	14.0	13.2	12.4	11.6	10.7	9.9	9.1	8.2
48	16.9	16.0	15.2	14.4	13.5	12.7	11.8	11.0	10.1	9.3	8.4
54	17.5	16.6	15.5	14.9	13.8	13.1	12.1	11.4	10.4	9.6	8.7
60	17.0	16.1	15.3	14.5	13.6	12.8	11.9	11.1	10.1	9.4	8.5

*Girls*

3	13.3	12.7	12.0	11.3	10.6	9.9	9.3	8.9	8.0	7.3	6.7
6	14.3	13.6	12.9	12.2	11.5	10.7	10.0	9.3	8.6	7.9	7.2
9	15.3	14.5	13.7	12.9	12.2	10.7	11.4	9.9	9.2	8.4	7.7
12	15.6	14.8	14.0	13.3	12.5	11.7	10.9	11.7	9.4	10.1	7.8
15	15.7	14.9	14.1	13.3	12.5	11.9	11.0	10.3	9.4	8.6	7.8
18	16.1	15.3	14.5	13.7	12.9	12.1	11.3	10.5	9.7	8.8	8.0
21	15.9	15.1	14.3	12.5	12.7	11.9	11.1	10.3	9.6	8.7	7.9
24	15.9	15.1	14.4	13.5	12.8	11.9	11.2	10.3	9.6	8.7	7.9
30	16.4	15.6	14.8	13.9	13.1	12.3	11.5	10.7	9.8	9.0	8.2
36	15.9	15.1	14.3	13.5	12.7	11.9	11.1	10.3	9.6	8.7	7.9
42	16.3	15.5	14.7	13.8	13.1	12.2	11.4	10.6	9.8	8.9	8.1
48	16.9	16.0	15.2	14.8	13.5	13.7	11.8	11.0	10.2	9.3	8.4
54	16.6	15.8	15.1	14.1	13.4	12.4	11.7	10.8	10.1	9.1	8.3
60	16.9	16.0	15.2	14.3	13.5	13.7	11.8	11.0	10.1	9.3	8.4

*Boys & Girls*

72	17.3	16.4	15.6	14.7	13.8	13.0	12.1	11.2	10.4	9.5	8.5
----	------	------	------	------	------	------	------	------	------	-----	-----



### Local Events Calendar to determine the Age

Shuklapaksha				Krishnapaksha				Other Festivals	
	Chaturthi	Ekadashi	Pournima	Chaturthi	Ekadashi	Amavasya			
Chaitra	1968	1-4-68	9-4-68	Hanumanjayanti 13-4-68	16-4-68	23-4-68	27-4-68	Gudhipadwa 29-3-68	Ramnawami 7-4-68
	1969	22-3-69	29-3-69	Hanumanjayanti 2-4-69	3-8-69	12-8-69	19-4-69	Gudhipadwa 14-3-69	Ramnawami 19-3-69
	1970	9-4-70	17-4-70	Hanumanjayanti 21-4-70	28-4-70	1-5-70	5-5-70	Gudhipadwa 7-4-70	Ramnawami 15-4-70
	1971	Sankasthi 30-3-71	1-4-71	Hanumanjayanti 10-4-71	Sankasthi 14-4-71	21-4-71	25-4-71	Gudhipadwa 27-3-71	Ramnawami 3-4-71
	1972	18-3-72	26-3-72	Hanumanjayanti 29-3-72	2-4-72	11-4-72	13-4-72	Gudhipadwa 16-3-72	Ramnawami 23-3-72
1973	7-4-73	13-4-73	Hanumanjayanti 17-4-73	21-4-73	28-4-73	2-5-73	Gudhipadwa 4-4-73	Ramnawami 11-4-73	
Vaishakh	1968	1-5-68	8-5-68	16-5-68	15-5-68	22-5-68	26-5-68		Akshaytritiya 29-5-68
	1969	20-8-69	23-8-69	Buddhajayanti 2-4-69	5-5-69	12-5-69	16-5-69		Akshaytritiya 19-5-69
	1970	8-5-70	17-5-70	Buddhajayanti 21-5-70	24-5-70	31-5-70	4-6-70		Akshaytritiya 7-5-70
	1971	28-8-71	6-5-71	Buddhajayanti 10-5-71	13-5-71	21-5-70	24-5-71		Akshaytritiya 27-4-71
	1972	17-4-72	25-4-72	Buddhajayanti 29-4-72	2-5-72	10-5-72	13-5-72		Akshaytritiya 15-5-72
1973	6-5-73	12-5-73	Buddhajayanti 17-5-73	21-5-73	28-5-73	31-5-73		Akshaytritiya 3-6-73	

1968	31-5-68	7-6-68	Wadapournima 10-6-68	13-6-68	21-6-68	25-6-68	
1969	20-5-69	27-5-69	Wadapournima 31-5-69	30-6-69	10-6-69	11-6-69	
1970	7-6-70	15-6-70	Wadapournima 19-6-70	22-6-70	29-6-70	3-7-70	
1971	28-6-71	4-6-71	Wadapournima 6-6-71	12-6-71	19-6-71	22-6-71	
1972	14-6-72	22-6-72	Wadapournima 26-6-72	30-6-72	8-7-72	10-7-72	
1973	4-6-73	11-6-73	Wadapournima 15-6-73	20-6-73	27-6-73	30-6-73	Pandharpur Fair 11-7-73

1968	29-6-68	Pandharpur Fair 6-7-68	10-7-68	13-7-68	21-7-68	25-7-68	Deep Puja
1969	18-7-69	25-7-69	29-7-69	1-8-69	8-8-69		Deep Puja
1970	7-7-70	15-7-70	18-7-70	21-7-70	18-7-70	2-8-70	12-8-69
1971	26-6-71	Pandharpur Fair 4-7-71	8-7-71	11-7-71	19-7-71	22-7-71	Deep Puja
1972	14-7-72	21-7-72	26-7-72	29-7-72	6-8-72	10-8-72	Deep Puja
1973	4-7-73	10-7-73	15-7-73	19-7-73	26-7-73	29-7-73	Deep Puja

(continued)

Shuklapaksha				Krishnapaksha			Other Festivals	
	Chaturthi	Ekadashi	Pournima	Chaturthi	Ekadashi	Amavasya		
Shrawan	1968	29-7-68	5-8-68					
			Narlipournima					
			8-8-68	11-8-68	19-8-68	Pithori	Nagpanchmi	Goculastami
	1969	16-8-69	23-8-69	30-8-69	5-9-69	Pithori	Nagpancham	Goculastami
			27-8-69			11-9-69	17-8-69	3-8-69
1970	6-8-70	13-8-70	17-8-70	20-8-70	27-8-70	Pithori	Nagpanchmi	Goculastmi
			Narlipournima			31-8-70	7-8-70	23-8-70
1971	26-7-71	3-8-71	6-8-71	9-8-71	16-8-71	Pithori	Nagpanchmi	Goculastmi
		Pandharpur	Narlipournima			20-8-71	27-7-71	14-8-71
1972	12-8-72	21-8-72	24-8-72	27-8-72	5-9-72	Pithori	Nagpanchmi	Goculastmi
			Narlipournima			7-9-72	14-8-72	31-8-72
1973	2-8-73	9-8-73	13-8-73	18-8-73	24-8-73	28-9-73		
Bhadrapad	1968	27-8-68	3-9-68	10-9-68	18-9-68	Sarwapitri	Haritaluka	Anantchaturdashi
		Ganpati	6-9-68			22-9-68	26-8-68	5-9-68
	1969	15-9-69	22-9-69	29-9-69	7-10-69	Sarwapitri	Haritalika	Anantchaturdashi
			25-9-69			10-10-69	14-8-69	24-9-69
	1970	8-9-70	15-9-70	23-9-79	30-9-70	Sarwapitri	Haritalika	Anantchaturdashi
			19-9-71			4-10-70	7-9-70	18-9-70
	1971	28-8-71	5-9-71	12-9-71	19-7-71	Sarwapitri	Haritalika	Anantchaturdashi
			9-9-71			24-9-71	27-8-71	7-9-71
	1972	11-9-72	19-9-72	26-9-72	3-10-72	Sarwapitri	Haritalika	Anantchaturdashi
			23-9-72			7-10-72	10-9-72	22-9-72
1973	31-8-73	8-9-73	12-9-72	16-9-73	22-9-73	Sarwapitri	Haritalika	Anantchaturdashi
						26-9-73	30-8-73	10-9-73



Ashwin	1968	26-9-68	3-10-68	Kojagiri 6-10-68	10-10-68	18-10-68	21-10-68	Dassera 1-10-68	Diwali 21-10-68
	1969	14-10-69	21-10-69	Kojagiri 25-10-69	28-10-69	6-11-69	9-11-69	Dassera 20-11-69	Diwali 9-11-69
	1970	3-10-70	10-10-70	14-10-70	17-10-70	23-10-70	30-10-70	Dassera 9-10-70	Diwali 29-10-70
	1971	23-9-71	30-9-71	Kojagiri 4-10-71	7-10-71	14-10-71	19-10-71	Dassera 29-9-71	Diwali 18-10-71
	1972	11-10-72	19-10-72	Kojagiri 22-10-72	25-11-72	3-11-72	6-11-72	Dassera 17-10-72	Diwali 5-11-72
	1973	30-9-73	8-10-73	Kojagiri 11-10-73	15-10-73	22-10-73	26-10-73	Dassera 7-10-73	Diwali 25-10-73
Kartik	1968	25-10-68	31-10-68	Tripuri 4-10-68	17-11-68	8-11-68	20-11-68	Bhaubij 23-10-68	Tulsilangna 2-11-68
	1969	13-11-69	20-11-69	23-11-69	26-11-69	5-11-69	9-11-69	Bhaubij 11-11-69	Tulsilangna 20-11-69
	1970	2-11-70	9-11-70	13-11-70	16-11-70	24-11-70	28-11-70	Bhaubij 31-10-70	Tulsilangna 10-11-70
	1971	23-10-71	30-10-71	2-11-71	5-11-71	13-11-71	18-11-71	Bhaubij 20-10-71	Tulsilangna 29-10-71
	1972	10-11-72	17-11-72	20-11-72	23-11-72	2-12-72	6-12-72	Bhaubij 7-11-72	Tulsilangna 16-11-72
	1973	30-10-73	2-11-73	10-11-73	14-11-73	20-11-73	25-11-73	Bhaubij 28-9-73	Tulsilangna 7-10-73

(continued)



Shivratri  
15-2-69  
Shivratri  
11-3-70  
Shivratri  
24-2-71  
Sankrant  
13-2-72  
Shivratri  
3-3-73

1969	21-1-69	29-1-69	2-2-69	5-2-69	13-2-69	16-2-69
1970	11-2-70	18-2-70	22-2-70	27-2-70	8-3-70	12-3-70
1971	30-1-71	6-2-71	10-2-71	13-2-71	21-2-71	25-2-71
1972	19-1-72	26-1-72	30-1-72	2-2-72	11-2-72	14-2-72
1973	7-2-73	14-2-73	17-2-73	20-2-72	1-3-73	4-3-73

Magh

Rangpanchmi  
8-3-69  
Rangpanchmi  
23-3-70  
Rangpanchmi  
16-3-71  
Rangpanchmi  
5-3-72  
Rangpanchmi  
23-3-73

				7-3-69	14-3-69	17-3-69
				23-3-70	30-3-70	3-4-70
				15-3-71	23-3-71	26-3-71
				3-3-72	10-3-71	15-3-72
				22-3-73	30-3-73	3-4-73

Holi  
3-3-69  
Holi  
18-3-70  
Holi  
11-3-71  
Holi  
29-2-72  
Holi  
18-3-73

1969	20-2-69	27-2-69	3-3-69
1970	8-3-70	14-3-70	18-3-70
1971	28-2-71	7-3-71	11-3-71
1972	18-2-72	25-2-72	29-2-72
1973	8-3-73	15-3-73	18-3-73

Phalgun









## ABOUT THE BOOK

In *Early Detection and Prevention of Protein Calorie Malnutrition*, Dr. P. M. Shah describes methods for the detection of incipient malnutrition which have been so simplified, through improvisation, that paramedical workers, and even village assistants with little training, can easily and quickly assess grades of child and infant malnutrition at village-level clinics, or at village homes.

Dr. Shah writes in depth about the living conditions which generate malnutrition and, based on his many years of first-hand experience in health and nutrition programming in rural India, about the practical measures that can be taken—when normal constraints of manpower, money and materials exist—to cure child malnutrition and prevent its recurrence.

## ABOUT THE AUTHOR

Dr. P. M. Shah is Professor of Paediatrics at the Institute of Child Health of Grant Medical College and the J. J. Group of Hospitals in Bombay. Since 1964, he has been the Visiting Paediatrician to the Rural Health Unit at Palghar, Thana District. Palghar Block is the site of the WHO-Aided Project on the Domiciliary Treatment of Protein-Calorie Malnutrition, of which Dr. Shah is the Principal Investigator. He is also the Hon Technical Director of the Model Integrated Mother-Child Health-Nutrition Project at the Kasa Primary Health Centre, which is sponsored by the Government of India, the Government of Maharashtra and CARE-Maharashtra. The author is a member of the World Health Advisory Panel to the Government of India on Maternal-Child Health and Family Planning.

In addition, since 1968, Dr. Shah has been the tutor at Bombay for the UNICEF/WHO course in Child Health for Senior Teachers from developing countries. He was the convenor of the Nutrition Sub-committee of the Indian Academy of Paediatrics and edited the proceedings of three All-India workshops which the Sub-committee organised in 1971 and 1972.